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ANALYSIS OF THE AIRCRAFT FLYING HOUR
PROGRAM AT THE PACIFIC MISSILE TEST CENTER

by

Vanessa J. Byrne

December 1987

Thesis Advisor: Shu Liao

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Analysis of the Aircraft Flying Hour Program at the Pacific Missile Test Center

by

Vanessa J. Byrne
Lieutenant, United States Navy
B.A. Ohio Wesleyan University 1974

Submitted in partial fulfillment of the requirements for the degree of

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from the

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ABSTRACT

This thesis is an analysis of the flight hour cost program at the Pacific Missile Test Center (PMTC). The method by which PMTC computes aircraft flight hour rates is compared to the techniques used by the Naval Air Test Center and the Naval Weapons Center. A new approach to computing aircraft rates is proposed in this report. Using historical cost data, regression analysis is used to derive a rate per hour flown for fuel consumption. Based upon these data, no correlation exists between aircraft flight hours and aircraft parts costs. A decision support system (DSS) is also proposed herein to assist in the calculation of the flight hour rates. This DSS can also be used as a budget and as a vehicle to track program cost and schedule variances. It is recommended that a follow-on analysis be conducted to ascertain whether or not a true correlation exists between flight hours and aircraft parts costs. Under the current budget system, funds for parts are requested per hour in the Navy and Marine Corp flying hour program.

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I. INTRODUCTION

Within the Department of Defense there are few opportunities to study and analyze a service activity which has an accounting system similar to that used in the private sector; that is, a system under which revenue is generated to meet expenses. There are a few exceptions; however, and within the U.S. Navy these organizations are designated Industrial Fund activities. Strict criteria must be met in order for an activity to qualify for this designation:

> Establishment of an activity for operation under an industrial fund will be based on the criterion that the installation is an industrial or commercial type activity engaged in producing goods or providing services, in response to requirements of users and central management organizations, that are common within and among Department of Defense components. (Ref. 1)

Within the Navy, there are only three organizations which fly and maintain aircraft under the Navy Industrial Fund (NIF) concept. These are the Naval Air Test Center at Patuxent River, Md., the Naval Weapons Center at China Lake, Ca., and the Pacific Missile Test Center at Pt. Mugu, Ca.

This study focuses on the fund which is used by the Pacific Missile Test Center (PMTC) to support aircraft operations. Under the NIF concept, this account is a revolving fund. Customers pay into the account when they use PMTC's aircraft. All of the costs to support and maintain the airplanes are paid for out of this same fund.

A. OBJECTIVES

The first objective of this study is to examine the management and control of the aircraft account. A second objective is to compare how the price per flight hour for the aircraft is determined by the different test centers. The price charged the user or customer is called an aircraft flight hour rate (FHR). Under the NIF system, these three test centers compete with each other for research, development, test and evaluation (RDT&E) work.

This analysis breaks down the FHR into fixed and variable costs. Regression analysis is used to find a rate per hour flown for the variable costs. The allocation of fixed costs is reviewed. The method by which these costs are disbursed is compared to techniques used by these competing RDT&E activities. An alternative approach to computing the FHR is presented here, based upon historical cost information. After these data have been compiled, a model is developed for each aircraft FHR. These equations are incorporated into a decision support system (DSS), which can be used to enhance planning and control of the aircraft operations and support account. More specifically, planning and control can be improved through the use of a budget. This budget, which is developed as part of the DSS, is a vehicle to be used by management to calculate the FHR and, as the year progresses, the budget can be used to compare the actual rate of flying the aircraft to the rate being charged the customer. A final objective of this study is to enable the use of a desktop computer to house the DSS, effectively automating a process which to date has been a manual operation for PMTC. The computer model allows the aircraft maintenance manager, or decision maker, to test various options when setting the aircraft FHR, thereby improving resource allocation. The computer model also frees personnel from tedious calculations, thus more time can be spent on analysis and on the implementation of cost control measures.

B. ORGANIZATION OF THIS STUDY

Chapter II gives the reader background information on the aircraft FHR determination process at PMTC. In Chapter III, the FHR equations used by each test center are compared. Chapter IV entertains a new approach to computing the rates for the aircraft at PMTC. This chapter also contains the results of the regression analysis. A rate per hour flown is found for fuel consumption for each aircraft. A rate per hour for parts could not be calculated as no correlation exits between aircraft flight hours and parts costs. Chapter V brings the new aircraft FHR models together into the DSS. Chapter VI contains various recommendations for implementation at the Pacific Missile Test Center. If implemented, these suggestions can serve as aids to the decision making process and will improve management of the aircraft account at the Pacific Missile Test Center.

C. SUMMARY OF FINDINGS

An assumption that was made at the beginning of this work was that two cost elements, incurred during normal operation of the aircraft, were variable. These elements are fuel and parts costs which are required to support the airplanes. Regression analysis did not confirm this assumption. Only fuel was found to vary in relation to aircraft flight hours. Therefore, the conclusion which must be made is that parts required to maintain the aircraft are not directly related to the hours flown. Flight hours, as a measure of the activity level of an organization, should not be used for budgeting and planning purposes for part cost estimations.

II. BACKGROUND

The Pacific Missile Test Center (PMTC) is one of several test centers whose mission is research, development, test and evaluation (RDT&E) of naval weapon systems. Specifically, PMTC is tasked "to perform development test and evaluation, development support, and follow-on engineering, logistic, and training support for naval weapons, weapon systems, and related devices; and to provide major range, technical and base support for Fleet users and other Department of Defense and government agencies (Ref. 2)."

A significant amount of PMTC's RDT&E work is done using naval aircraft as a test platform. These aircraft are employed as primary project testbeds and they are used in a support role to monitor active aerial test such as missile and drone deployments.

Aircraft are assigned by mission to directorate/departments within PMTC. The aircraft which are used for project execution are detailed to the Systems Evaluation Directorate/Weapons System Test Department. Range support aircraft are assigned to the Range Directorate/Range Operations Department. Logistics and station support aircraft are under the cognizance of the Naval Air Station/Air Operations Department. Aircraft maintenance and support is the responsibility of the Aircraft Maintenance Officer. Table 1 shows the assignment of aircraft by Directorate/Department and the projected inventory level for fiscal year (FY) 1988.

Flying time at PMTC is divided into two areas. User or project hours are those flown by the test and support aircraft. Tests are either ordered by program/project offices in Washington, D.C. or they are suggested by the directorates. The other

TABLE 1

AIRCRAFT ASSIGNED TO PMTC FY 88

Weapons System Test	A3	Skywarrier	4
	A6	Intruder	1
	F4	Phantom	3
	F14	Tomcat	5
	A7	Corsair	4
	F/A18	Hornet	7
Air Operations	H46	Sea Knight	4
	UC12	Super King	1
Range Operations	P3	Orion	7

type of flying time is readiness hours which are flown for training and aircrew proficiency. Appendix A depicts user and readiness flying hours for the whole test center and by aircraft model from FY 82 through FY 86.

Test and evaluation project offices are located within the Systems Evaluation Directorate. These program offices are staffed with test pilots, test engineers and support personnel. The program offices report to PMTC, however, they work closely with the weapons system program managers at the Naval Air Systems Command (NAVAIR), who provide most of the funding for the aircraft project flying.

One of the many functions of PMTC is to provide aircraft maintenance, administrative and logistic support for all assigned aircraft. This includes the operation and maintenance of facilities, technical and quality assurance services, and repair and supply of aircraft parts. Aircraft maintenance consists of both organizational and intermediate level repair.

Aircraft maintenance and operations expenses are paid for by a holding account, which is essentially an unfunded account. The Pacific Missile Test Center is not given any money directly at the beginning of the fiscal year. Users of PMTC's aircraft, the project offices, are billed by the comptroller's office at a preestablished rate per flight hour flown. In effect, the aircraft is rented. This fee, for each hour flown, is referred to as an aircraft flight hour rate (FHR).

Money for flying the aircraft comes from two different sources. The program offices at NAVAIR determine how much money their program can afford and the money is forwarded to the program offices within the Systems Evaluation Directorate. The Commander of PMTC receives monies from NAVAIR for the training of aircrew personnel. After each flight, funds at the preestablished FHR are transferred to the unfunded or holding account. This money is considered income or revenue.

Revenue generated by the use of the aircraft is applied against outstanding bills for fuel, labor, parts and consumables, thus paying for the upkeep and support of the aircraft. Revenue can only pay for aircraft bills. Like a non-profit organization, PMTC's charter is to break-even rather than make or lose money. As such, PMTC theoretically starts and ends each fiscal year at zero, but must pay all bills in between. The Pacific Missile Test Center is forced to ensure its existence by competing with other test centers. If the predetermined flight hour rates are too high, no one will want to fly out of PMTC. If the aircraft are not flown, PMTC will not be able to cover its fixed costs. Because the fleet is always in need of more aircraft, PMTC is continuously under pressure to prove that the aircraft are being fully utilized. PMTC needs to be able to justify keeping the aircraft inventory at current levels. Thus the flight hour rate charged must be carefully controlled to a) meet the requirement of starting and ending the year with no money on the

books, b) to ensure that all fixed costs are met and c) to fly enough hours to justify the current inventory of aircraft.

The process for determining aircraft flight hour rates begins each fiscal year at PMTC with the Comptroller submitting proposed rates to the Aircraft Requirements Board (ARB). The Aircraft Requirements Board is chaired by the Weapons System Test Officer and membership includes the heads of major departments which have a stake in the aircraft flying hour program. Project officers attend as well. These boardmembers are familiar with both the aircraft flight hour accounting program and the requirements of specific flight test projects. They know what NAVAIR programs can and can't afford. They know what it takes to keep the aircrews proficient. Flight hour rates are determined by consensus. These FHR's are then passed on as recommendations to the Admiral, Commander Pacific Missile Test Center. The Admiral is the final authority on the aircraft rates. The Aircraft Requirements Board continues to meet throughout the year, on a quarterly basis. Any changes to the FHR's which are required in order to "balance the budget" are forwarded to the Admiral for his consideration.

Historically, PMTC has successfully maintained this delicate balance, matching revenues generated with costs incurred for normal aircraft operations. Table 2 shows that the variance at the end of each fiscal year for the past five years is two percent or less of total revenue generated. This is a significant achievement.

In the past, however, PMTC has encountered some difficulties in managing the aircraft account. These problems have centered around finding just the right rate to charge per flight hour for each aircraft. These difficulties are best illustrated by tracing the flight hour cost history for one aircraft. The F14 aircraft has been selected because the flight hour rate for this aircraft has been quite volatile over the

TABLE 2

PMTC REVENUE/EXPENSE HISTORY

FY	Revenue	Expense	Variance	Var/Rev
1982	$18,099,821	$17,886,435	$212,386	1.1%
1983	18,279,025	17,946,588	332,437	1.8%
1984	17,857,316	17,741,434	115,882	.6%
1985	16,950,698	17,297,596	(346,898)	2.0%
1986	18,928,331	19,156,921	(228,590)	1.2%

years and has challenged the accounting practices for the aircraft holding account, forcing changes to the system.

Up until FY 81, NAVAIR (Program Manager Air-241) paid for contracted aircraft maintenance labor costs for the F14. These labor costs included two contracts, one with Grumman Corporation, the other with Hughes Aircraft Corporation (now a subsidiary of McDonnell Douglas Corporation). In FY 81 PMA-241 revised its policy and required PMTC to fund the labor costs for the F14. The inclusion of these labor costs into the F14 aircraft flight hour rate in midyear 1981 drove the rate from $3700 per hour up to $6700 per hour. In FY 82, when the labor costs for the F14 had to be fully-absorbed by PMTC, the price of the FHR increased again to $7690. During this same time, the Naval Air Test Center at Patuxent River, Md. was charging $3868 for this aircraft. Top management at PMTC became concerned over the disparity in these flight hour rates. The Comptroller's office was directed to investigate the problem and to recommend changes in order to bring down the cost of flying the aircraft. Two different tacks were used to try to identify potential savings. All in-house costs were reviewed to trim any excess

in expenditures and to ensure that the aircraft was not paying more than its fair share of costs. The second approach was to look into the techniques used by other RDT&E activities for establishing flight hour rates and allocating costs.

The in-house study revealed that there were a number of steps which could be taken to cut costs. Mostly, these cost-cutting measures were aimed at a "fair share" distribution of overhead or fixed costs between all of the commands on station. The Pacific Missile Test Center is host to four other commands which fly and maintain aircraft at Pt. Mugu. These commands are considered tenant.

One of the issues which surfaced was that, historically, PMTC had charged these tenant commands less than their fair share of Intermediate Level maintenance labor costs and material and labor costs to support common use ground support equipment (GSE). The problems associated with undercharging tenant commands for GSE still plagues PMTC today. In a report presented to the Aircraft Maintenance Officer in April of this year, an undergraduate student disclosed that GSE costs were not being equitably distributed and that PMTC was paying the lion's share of these costs (Ref. 3). Under the present system, the user which last held custody of the ground support equipment is charged all labor and material costs to repair the equipment. In his report, Raul Becerra, showed that in FY 86 PMTC paid for 66.4% of all of the GSE costs on station. Other measures of activity indicated that PMTC's actual use of GSE was well below this level: aircraft assigned, 44.8%; flight hours flown, 22.1%; fuel consumption, 34.3%; sortie rate 25.9%. The report's final recommendation is that costs be allocated as a percentage of fuel consumption. The report is currently under review. If adopted, this plan could save PMTC up to one million dollars a year.

There is, however, some reluctance on the part of the maintenance managers at PMTC to abruptly change the cost allocation policy for ground support equipment.

It is felt that any change should be incremental so that tenant commands can easily adjust to these changes. This way the cost increases can be absorbed into their current budgets. (Ref. 4).

The incremental approach is an important and familiar concept in fiscal accounting. Aaron Wildavsky, a noted political scientist, explains:

> Budgeting is incremental, not comprehensive. The beginning of wisdom about an agency budget is that it is almost never actively reviewed as a whole each year in the sense of reconsidering the value of all existing programs as compared to all possible alternatives. Instead, it is based on last year's budget with special attention given to the narrow range of increases or decreases. Thus the men who make the budget are concerned with relatively small increments to an existing base. Their attention is focused on a small number of items over which the budgetary battle is fought. (Ref. 5)

Incremental change is introduced here because it is a recurring theme and the concept will re-emerge in later chapters. It may serve to keep in mind that the aircraft program offices in Washington are deeply involved in the politics of the "budget battle" and that incremental changes are the ones that are most easily accommodated from year to year.

Another alternative, other than the incremental approach, is to delay the implementation of the new GSE charging policy until the tenant commands can get a commitment from their higher echelon commanders to cover the large increases in their "fair share" of GSE costs.

So, we've seen that a cost allocation problem, GSE costing, originally associated with the F14 FHR dilemma of FY 81, is still an active issue at PMTC.

The second tack that the Comptroller undertook in FY 81 to reduce the F14 flight hour cost changed the way PMTC did business. The evaluation of other T&E centers accounting methods led to the discovery that NATC was "normalizing"

aircraft labor costs. Under normalization, labor costs were distributed to all aircraft in spite of the fact that many of the aircraft had no direct labor costs. The aircraft with no direct labor costs are maintained by active duty naval personnel. The practice of normalizing costs had been sanctioned by the Comptroller of the Navy (NAVCOMPT). This method of cost allocation was viewed by NAVCOMPT as an effective management tool:

> Where necessary, activities may develop and apply an average hourly rate to recover organizational level maintenance costs performed on more than one aircraft model by a combination of military and civilian labor. This procedure is intended to level out cost differences between aircraft models for the same type of maintenance which is caused solely by assignment of military labor to one aircraft model and civilian labor to another. It also recognizes the management initiatives in attempting to obtain the lowest possible cost for aircraft support. This procedure permits certain organizational level support to be treated as organic to an activity rather than aircraft peculiar for the purpose of applying fair and reasonable hourly rates to all users. (Ref. 6)

The Pacific Missile Test Center adopted a similar version to this normalizing practice in May of 1982. The flight hour rate for the F14 dropped to $6350 per hour. Memoranda from that time period indicate that the officers at PMTC were still concerned with the high aircraft FHR for the F14 (Ref. 7). In January of 1983, the Admiral directed full implementation of "normalization." The flight hour rate for the F14 dropped to $4400 per hour.

Normalization of aircraft rates has not been a panacea or cure-all for PMTC. In FY 83 the rates were changed twice, all increases except for the F14. In FY 84, the rates were changed twice again, this time all changes were downward. Fiscal Year 85 was a repeat of FY 83, all rates went up twice, including a change to the F14 aircraft. In FY 86, the rates only changed once. In FY 87 the rates changed

twice, both times downward. Appendix B lays out these changes for each aircraft model.

A curious anomaly has been noted as a result of this study. While PMTC has used the normalization process to determine aircraft flight hour rates and these normalization costs are reported to higher echelon commands quarterly, this policy has not been applied to actual cost allocations. These actual costs are used in-house as a way to compare the established rate with actual costs incurred. Thus PMTC is operating under two distinct accounting systems governing one operation. Ground support equipment, Intermediate Level maintenance and some labor costs not directly charged to the aircraft are being allocated on a flight hour basis, much as they were prior to the implementation of the normalization policy in 1983.

Another interesting development is that NATC no longer uses "normalization" for fixed costs. The Naval Air Test Center's new method will be discussed in detail in the next chapter.

III. THE AIRCRAFT FLIGHT HOUR RATE

This chapter will explain in detail how each of the test centers calculates the aircraft flight hour rates (FHR's). Before we begin, however, some background information on budgeting and cost allocation is provided to assist the reader in understanding the rate computation process. General guidelines will be discussed as well and, in conclusion, FHR's will be presented for those aircraft which are common to all three test centers.

A. THE BUDGET AND COST ALLOCATION

The aircraft flight hour rate can be regarded as a derivative of the master budget. If each aircraft flight hour rate were to be multiplied by the planned or forecasted number of flight hours (volume or activity), and if these resulting figures were added together for all the aircraft, the sum total would equal anticipated revenue. For any government organization, which must balance revenues and expenses, this sum total also matches anticipated costs or expenses.

1. The Budget

Each aircraft flight hour rate can be broken down into components for the different elements of expense, such as fuel, labor and parts. These components can be grouped into two categories: fixed or variable costs.

Variable costs are those costs which vary with a change in volume or activity. In the case of aircraft, fuel can be considered a variable cost because for each flight hour flown, fuel is consumed. There is some controversy as to whether or not parts are variable costs. This issue will be addressed in greater depth later in this and subsequent chapters.

Fixed costs are those costs which do not change with activity volume. Fixed costs must be paid for no matter what. For our purposes, any costs which cannot be directly related to one particular aircraft's activity are considered fixed.

There is a key element in this budgeting process. This element is the level of activity or volume, flight hours (FH). Flight hours have an important impact on the fixed cost element of the FHR. As flight hours increase, fixed cost per hour decrease and vice versa.

As each fiscal year begins a budget is set through the aircraft flight hour rate determination process. As costs are incurred they are allocated to the various cost elements of expense.

2. Cost Allocation

Costs can be incurred under three distinct conditions and they are allocated accordingly.

a. Specific Segment or Object

The first means by which a cost is incurred is for a specific segment or object. Parts costs fall into this category. As parts fail, they are repaired or replaced, whether or not the aircraft flies.

b. Measurable Causal Relationship

Secondly, costs can be incurred for segments with measurable causal relationship. These costs are allocated by the causal factor. Fuel is the best example here. As each hour is flown, a certain amount of fuel is consumed and the cost is allocated to that aircraft model.

c. General Purposes

The last way in which costs can be incurred is for general purposes. These are common costs. They are allocated on an arbitrary basis. There are three accepted allocation methods for these general purpose costs:

1. **Total Cost Input**. This technique distributes costs as a percentage of total direct costs. This method is the one employed by NATC today.

2. **Value Added Cost Input**. This system applies to the private sector only. It is a means of distributing profit share.

3. **Single Element Cost Inputs**. Costs are allocated based upon one factor of operation. This procedure is being used by PMTC. Indirect costs incurred are being distributed by PMTC as a percentage of flight hours flown.

3. <u>The Flexible Budget</u>

The link between actual costs, incurred and allocated, and the master budget is what is commonly referred to as the flexible budget. The flexible budget helps us to measure performance and to control costs. The difference between the master budget, the flexible budget and actual costs can be subdivided into cost variance and schedule variance, as illustrated in Table 3.

TABLE 3

FLIGHT HOUR ACCOUNT VARIANCES

Master Budget	Flexible Budget	Actual Costs
(estimated FH) X (estimated FHR's)	(actual FH) X (estimated FHR's)	

Schedule variance   Cost variance

Schedule variance analysis can be conducted to assess the difference between planned and actual levels of activity. Schedule variance analysis is being accomplished at PMTC in the form of "howgozit" reports, which are issued by

the Weapons Systems Test Directorate. Appendix C contains samples of these "howgozit" reports.

Cost variance analysis focuses on the difference between actual costs and budgeted costs. Cost variance analysis is being performed by PMTC's Comptroller's office, but to a limited degree. By subtracting total cost incurred from total revenue generated, a variance is being calculated per model aircraft. The Comptroller provides this information monthly to the various department heads. It is difficult to glean from this monthly report, however, just exactly what the cost variance, positive or negative, is attributable to, be it parts, labor or fuel.

4. Guidelines

Before we begin a detailed examination of how the aircraft FHR's are being computed and how the budget is set, it is appropriate to digress a moment to discuss some of the unwritten rules or guidelines that apply to the RDT&E budget process. These guidelines help senior management, the strategic level of management, to ensure the delicate balance where revenues equal expenses (Ref. 8). These strategic planning concepts are maintained because of the need to 1) break-even, 2) fly the aircraft and 3) make maximum use of program and aircrew personnel.

a. Flight Hour Estimates

The first concept is that flight hour estimates must be tempered with historical information. There is a tendency on the part of the program offices to overestimate the number of flight hours they believe they will fly in the upcoming year. If the projected hours are not flown, insufficient revenue will be generated to cover costs. This is a conservative approach.

b. FHR Planning

The second maxim is that prior planning is important. The flight hour rates should be set early so that the program offices can advise their counterparts

in Washington. The Washington offices can then plan their own budgets. At the same time, the FHR's should not be set so far in advance of the coming year as to require input data which is unreliable.

c. FHR Changes

The next precept is that incremental changes in the FHR's are advisable. Wildly fluctuating rates are impossible for the activity program offices to manage. Incremental changes apply to both increases and decreases to FHR's.

d. FHR Determination

Another general rule is that rates are set higher at the beginning of the fiscal year. There are two reasons for this: 1) costs invariably increase from one year to the next due to inflation and 2) the conservative approach of limiting the flight hours forces fixed costs to be apportioned over a smaller flight hour base. Usually, the test centers operate at a deficit for the first two quarters of the fiscal year, as fewer hours are flown over the winter months. The pace of flying increases during the spring and summer months, and the rates are then reviewed and modified, if necessary. Ideally, the rates should be set only once for each fiscal year and never changed. However, in order to do this there would have to be perfect information on all of the projected expense elements. Because perfect information is not available, this conservative approach is preferred. Although it is common practice at the Naval Weapons Center and the Naval Air Test Center to set the rates higher initially, this is not recommended as there might be an adverse impact on the hours flown in the winter months. Program offices might be discouraged from flying in the winter months and the problem of generating enough revenue will only be exacerbated.

e. Breakeven Planning

The revenue/expense gap can be closed to the breakeven point by manipulating two factors:

(1) Decrease/Increase the FHR's. If the conservative approach has worked, as the year progresses, more revenue than necessary will be generated than there are bills to pay. The aircraft FHR's can be reduced towards the end of the fiscal year. Again, these changes should be incremental. If insufficient revenue is generated during the high flying months, the FHR's will have to be increased.

(2) Cost Controls. Aircraft maintenance managers are able to control discretionary costs. It should be emphasized, though, that these efforts usually produce results in the long term and their actions should not be counted on as immediate cost saving measures. Examples of cost-cutting steps include: newer and more effective test equipment can be purchased for trouble shooting the aircraft; maintenance personnel can be trained to repair additional equipment; intermediate aircraft maintenance support can be arranged with other fleet or field activities; labor cost can be reduced by hiring fewer contractors and increasing military manning (very difficult to do).

It is apropos to mention that it is more expensive to maintain an RDT&E aircraft than a fleet aircraft. Many of these aircraft are obsolete (no longer used by the fleet). They are specially configured for test and evaluation. They are prototypes, one of a kind airplanes. Sometimes these aircraft are not fully utilized, but they are kept in inventory, because there are plans to use a special feature or capability of that aircraft in future testing. Finally, as previously discussed, some of the aircraft are maintained by contracted labor, a cost the fleet does not incur.

B. AIRCRAFT FHR COMPUTATIONS AT THE RDT&E CENTERS

This section is devoted to a detailed comparison of how the aircraft FHR's are calculated. Each test center's FHR model will be explained in depth.

1. Data Requirements

Before the flight hour rate determination process can begin, data must be collected from various sources:

- fixed cost information: from the Aircraft Maintenance Officer (based on previous experience data).
- flight hours: from the program offices.
- funds available for training flights: Naval Air Systems Command.
- price of fuel: Comptroller of the Navy.

2. The Naval Weapons Center (NWC) Flight Hour Rate

The Naval Weapons Center at China Lake uses the now familiar normalization policy for establishing the aircraft FHR's. This procedure works well for them and they are able to fly their aircraft at competitive rates (Ref. 8).

The flight hour rate formula for NWC is built on four equations. Maintenance man hours per flight hour (MMH/FH) are the number of hours required to maintain a type of aircraft for each hour of flying.

a. First, MMH/FH for each type aircraft are multiplied by the projected FH for that aircraft. For example, for the A7 aircraft, the first equation might be:

$$70 \text{ MMH/FH } \times 300 \text{ FH } = 21,000 \text{ TOTAL MMH}$$

b. Next, all maintenance costs, less fuel, are divided by the total MMH for all aircraft. To arrive at the MMH for all aircraft, the 21,000 total MMH for the A7 is added to the total MMH for all of the other assigned aircraft. In our example, this total is 280,000 MMH for all aircraft. From this division we get the MMH rate:

$$\frac{\$7{,}000{,}000 \text{ MAINT COSTS ALL AIRCRAFT}}{280{,}000 \text{ MMH ALL AIRCRAFT}} = \$25\text{MMH RATE}$$

c. This MMH rate is multiplied by the MMH/FH for each type of aircraft to derive the maintenance costs per hour for that aircraft. For our example A7:

$$\$25 \text{ MMH RATE } \times 70 \text{ MMH/FH } = \$1750 \text{ MAINT COST/HR}$$

d. The new aircraft flight hour rate comes from the addition of the maintenance cost per hour (above) and the cost of fuel per hour:

$$\$1750 \text{ MAINT COST/HR } + \ \$650 \text{ FUEL COST/HR } = \$2400 \text{ FHR}$$

It should be noted that in using this formula the only cost which is explicitly defined as a variable cost is fuel. All others are treated as fixed. These fixed costs are reviewed periodically to validate the original projections.

3. The Pacific Missile Test Center (PMTC) Flight Hour Rate

The Pacific Missile Test Center's procedure for establishing aircraft FHR's is similar to the model used by NWC. Five equations are used to derive each FHR. These equations are presented below in Table 4 in the exact same format as found in a brief given by PMTC's Comptroller this fiscal year (Ref. 9):

There are some inconsistencies in these equations. For example, equations two and three are the same, yet, the purpose/effect column indicates that different solutions are derived from these identical equations. Also the value calculated in the first equation, the DMMH (direct MMH) rate, is not used in any of the follow-on calculations.

These equations are confusing. Rather than provide answers, they invite more questions. In fact, the process used by PMTC is almost identical to the models used by NWC. The only difference is that PMTC's parts costs are separated from the total maintenance costs and they are calculated as a single cost element. Parts costs are considered fixed by PMTC.

TABLE 4

PMTC AIRCRAFT COST NORMALIZATION PROCESS

	METHOD	PURPOSE/ EFFECT
1.	Total estimated maintenance cost ÷ total direct maintenance man-hours (DMMH) = DMMH rate.	Develop an average DMMH rate using PMTC cost/workload estimates.
2.	DMMH Fleet average (A/C type) × total estimated flight hours (A/C type) = DMMH by A/C type.	Use fleet 3M system averages to distribute DMMH to A/C type
3.	DMMH fleet average (A/C type) × total estimated flight hours (A/C type) = DMMH by A/C type.	Distributes maintenance costs to A/C type.
4.	Add maintenance costs to actual cost (fuel, material and parts).	Identifies total operating costs to A/C type.
5.	Operating costs ÷ estimated flight hours = A/C flight hour rate.	Sets proposed rate.

4. The Naval Air Test Center (NATC) Flight Hour Rate

The Naval Air Test Center's method of computing aircraft FHR's is considerably more complex. Their formula or model is no longer based on the normalization policy. The normalization method was abandoned in FY 84 and a new method implemented in FY 85. The reasons why normalization was abandoned by NATC are varied (Ref. 10). Their rates were skewed when compared to the rate of flying a fleet aircraft. Some of the rates were two to three times higher than the fleet. Others were far lower. The aircraft with low rates were over utilized;

the aircraft with high rates were idle much of the time. Not enough revenue was generated. The Naval Air Test Center began to lose business to other RDT&E activities.

The aircraft FHR's are calculated at NATC by using a Lotus 123 spreadsheet. A full breakdown of NATC's calculations is not included in this report. Appendix D is a copy of a sample of one NATC directorate's spreadsheet. The numbers in NATC's spreadsheet have been changed to protect the sensitivity of the information.

The Naval Air Test Center has several directorates that fly and maintain aircraft. The following is a summary of the aircraft FHR's for Strike Aircraft Test Directorate (the numbers have been changed here as well):

As one can see in Table 5, each FHR is composed of various elements. Each column represents one element, such as fuel, parts, labor:

- column A: aircraft type
- column B: institutional or training hours
- column C: project or user hours
- column D: total flight hours for the upcoming FY
- column E: fuel rate. (The fuel rate is computed by multiplying the fleet rate for fuel consumed per hour times the cost of fuel per hour.)
- column F: part rate. (This rate includes both the organizational and intermediate level parts costs. This is also a fleet rate.)
- The next six columns, G through L, are almost entirely labor costs, which are fixed costs. Each column represents labor at a different support activity within NATC. For example, column J, is for labor provided by the Supply Department. This labor rate pays for a contract for aircraft fuel truck drivers, supplying fuel to all of the aircraft on station.

TABLE 5

STRIKE FLYING HOUR RATE SUMMARY

A ACFT	B INST HRS	C USER HRS	D TOTAL HRS	E FUEL RATE	F PARTS RATE	G CONSUM RATE	H MPR RATE	I SAR RATE	J SU RATE	K AIMD RATE	L SY RATE	M CT RATE	N FH RATE
A-4	733	375	1,108	442	273	75	779	42	65	125	3	2	1,806
A-6	144	360	504	725	567	135	1,207	76	117	225	3	2	3,057
EA-6B	44	72	116	742	883	149	1,493	84	129	249	3	2	3,733
A-7	211	765	976	502	352	89	760	50	77	149	3	2	1,984
AV-8	46	145	191	524	667	82	1,200	46	70	136	3	2	2,729
OV-10	24	80	104	96	354	47	364	26	41	78	3	2	1,011
F-4	262	575	837	1,176	553	181	1,419	101	156	302	3	2	3,893
F-14	208	381	589	896	637	160	1,557	90	138	267	3	2	3,751
F-18	78	1,015	1,093	776	494	127	986	71	110	212	3	2	2,781

As previously mentioned in the cost allocation section of this chapter, these fixed costs are distributed by NATC based upon the total cost concept. A simplified illustration:

TABLE 6

TOTAL COST DISTRIBUTION

ACFT	FLT HRS	DIR RATE	TOT DIR	%	% LABOR	LABOR RATE
A4	10	5	50	.20	120	120
A6	20	10	200	.80	480	480
TOTAL			250	1.00	600	

All direct costs (fuel and parts) are added up for all type of aircraft (total direct column). A percentage is derived for each type aircraft using the total direct costs as the base. Fixed costs are then allocated using this derived percentage. Both fuel and parts are treated as variable cost by NATC.

- column M of the spreadsheet is a small amount added on to each FHR by NATC staff to generate revenue for bills which cannot be identified as belonging to one particular directorate.
- column N, the aircraft FHR, is the summation of columns E through N.

Using this spreadsheet, NATC is able to conduct sensitivity or what-if analysis. Values can be added or subtracted to/from any element to test the impact on the FHR. The flight hour rates can be manipulated, for example, to match a certain level of revenue for institutional or training funds. This is an important feature because institutional dollars for flying training flights are scarce and the RDT&E activities have had to live with fewer and fewer funds each year.

The Naval Air Test Center derives one additional benefit by using the Lotus 123 spreadsheet. That is, quarterly budgets can easily be extracted from the master spreadsheet. This is accomplished by duplicating the spreadsheet with the planned or forecasted FH for each quarter separately.

All of these aids to the decision-making process are not unique to NATC's spreadsheet. These features can be built into any microcomputer spreadsheet, be it Lotus 123 or any other comparable software package.

C. CONCLUSION

If success can be measured for these RDT&E activities, the best yardstick to use is the FHR for the same type aircraft. Below, in Table 7, are FHR's for aircraft which are common to all three test centers:

TABLE 7

AIRCRAFT FHR'S FOR NIF RDT&E CENTERS

	PMTC	NATC	NWC
A3	3800	NA	2325
A6	3800	3648	3075
A7	2200	2364	2025
F4	3800	4790	3050
F14	4000	4501	NA
F18	3100	3308	1825
H46	1100	1798	NA
C12	300	262	NA
P3	1900	2527	NA
As of:	May 87	Aug 87	Aug 87

The information in Table 7 is presented with a great deal of trepidation because there are many variables involved in the FHR determination process, and the numbers above may not be a true reflection of these variables. These figures can only be compared loosely. Yet, overall, it appears that, in the competitive price game, NWC is ahead of the other two RDT&E activities.

IV. THE MODEL

This chapter explores a new approach to computing aircraft flight hour rates (FHR's). Regression analysis will be performed on what are assumed to be variable costs, fuel and parts. Fixed costs will be distributed on the most relevant cost allocation basis. Finally, a Lotus 123 spreadsheet will be constructed, bringing together the proposed aircraft FHR models.

In the preceding chapter we found that there are three basic equations used by the test centers to determine the aircraft flight hour rates (FHR's). In the models used by the Naval Weapons Center (NWC) and the Pacific Missile Test Center (PMTC), only fuel is treated as a variable cost. All other costs are assumed to be fixed. At the Naval Air Test Center (NATC), both fuel and parts are considered variable. As noted, variable costs are costs which vary with a change in volume or activity. Variable costs are dependent upon a causal factor. Our causal factor is flight hours. For each hour flown, there is an effect which can be measured on fuel and/or parts costs. The equations used by each of the three activities are as follows:

- FHR=fuel/hr + parts costs + other allocated fixed costs (PMTC)
- FHR= fuel/hr + allocated fixed costs (NWC)
- FHR= fuel/hr + parts/hr + allocated fixed costs (NATC)

These equations are linear. They represent a straight line or relationship which can be depicted on a graph. An example is illustrated in Figure 1. The general equation for a line will have the form, $y = mx + b$. The letter y represents the dependent variable; values for y are found on the vertical axis of the graph. Values

for the independent variable, x, are located on the horizontal axis. The intercept of the y axis, b, is equal to fixed costs. The y intercept is also called the constant of the equation. The slope, m, is a measure of the change between any two points on a given line. The slope is referred to as the coefficient of the equation. The slope is the rate of change of the dependent variable (y) with respect to the independent variable (x). This rate of change is the first derivative of the line.

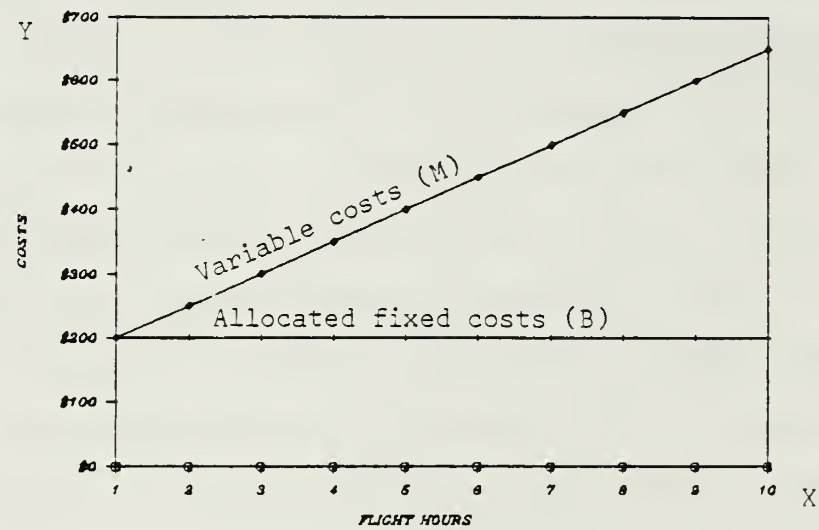


Figure 1
Graph of an Equation for a Line $Y = 200 + 50X$

In the previous chapter, we found that the aircraft flight hour rate could be regarded as a derivative of the master budget. This derivative is the rate per hour flown and it will become the focus of the variable cost analysis.

A. VARIABLE COST ANALYSIS

The principal task of this analysis is to ascertain whether fuel and parts are in fact fixed or variable. If there is a causal effect between flight hours and resources consumed, the dependent variable (y), the first derivative of the line will be used as the rate per hour for either parts or fuel. The goal is to find this derivative and therefore to find a rate per flight hour flown.

It is probably already intuitively obvious to the reader that a causal effect will be found between fuel costs and flight hours. Like a car, the aircraft simply won't run without fuel but the per flight hour consumption rate for each aircraft remains to be determined. Parts are a different matter, however. This study is an attempt to resolve the question of whether or not parts costs are variable (at least for PMTC) and, if they are variable, to find the rate per hour flown.

1. Methodology

Regression analysis was selected as the statistical technique best suited for this study. Regression analysis serves two purposes. First, regression analysis seeks to find the existence of a relationship between a change in volume or activity and a dependent element. If this relationship exits, it can be used to predict the dependent variable (y) given information about the independent variable (x). That is, given a change in (x), a regression equation can be used to calculate the change in (y). This rate of change is the slope of the line; it is the first derivative of the equation.

Given historical information, regression analysis finds a line, a relationship between two variables, which describes the data. Regression presents this line in algebraic format. The equation will also have the form, $y = mx + b$. Regression analysis also gives us statistics by which we can get an indication of how strong the correlation is between the dependent and the independent variables.

Three criteria will be used to measure the validity of the regression line. First, a statistical observation will be made on how close the data is to the regression line. Next, the significance of the regression line will be measured. Finally, the slope of the line will be tested for statistical significance. The three criteria to be used to test the regression line are R^2 , the F test and the T test.

The coefficient of determination, R^2 , is a goodness- of-fit test for the regression line as a whole. It describes how close the data points are to the regression line. This coefficient indicates how much of the total variance in the dependent variable (y) is explained by the independent variable (x) or the regression line. For example, if R^2 is equal to 56%, then the independent variable explains 56% of the total variation in the dependent variable. The remaining 44% of the variation is due to other influences such as other variables or chance.

The F test measures the statistical significance of the regression equation. The F test is the ratio of the variation of the dependent variable which is explained by the regression line to the variation which is unexplained by the same line. One would hope to find that the explained variation is large and that the unexplained variation is small, resulting is a large F test ratio. Typically, a significant regression line will have an F test which is greater than four.

The T test is used to measure the strength of the slope of the line to ensure that the slope is significantly different from zero. If the slope of the line is zero, there is no relationship between the dependent variable (y) and the independent variable (x). In this analysis, if the slope were zero, the interpretation would be that, for any given increase or change in flight hours flown, there would be no effect on the cost element in question. The T test is considered significant if its value is greater than two.

Test for significance is an important concept in statistical analysis. It is an inferential technique. "Significance testing allows us to evaluate differences between what we expect on the basis of our hypothesis, and what we observe ... significance testing will allow us only to evaluate the likelihood (or probability) of our results or observations... (Ref. 11)." Likelihood or probability is measured on a scale of zero to one and can be represented as a percentage or as a percent in our level of confidence, or as in the case of the T and F test, as a value greater than two or four respectively.

There is a subjective way to evaluate the regression line. This is by visual inspection. By simply examining a graph of historical data we can get a fairly reliable impression as to whether or not the regression analysis will have a favorable outcome. By simply looking at the graph, one can make a reasonable determination of 1) whether the slope of the line is flat (zero) or if it has a marked gradient and 2) how scattered the data points are, that is how close they are to the regression line. For purposes of illustration, an example is presented below for the historical fuel data on the F14 aircraft, Figure 2.

As can be observed above, these data are closely grouped around the regression line. There is a marked slope and the line originates close to the origin. Because the line is so close to the origin, the fixed costs are small and can be considered statistically insignificant.

2. Regression Analysis of Fuel Costs

Six years (FY 81 through FY 86) of monthly fuel consumption data were collected from financial records at the Pacific Missile Test Center (PMTC). These monthly records were formatted by model aircraft (e.g. P3A, RP3A, EP3A). The data were entered into a Lotus 123 spreadsheet and grouped by type of aircraft (e.g. P3). This step is consistent, as flight hour rates are set by aircraft type,

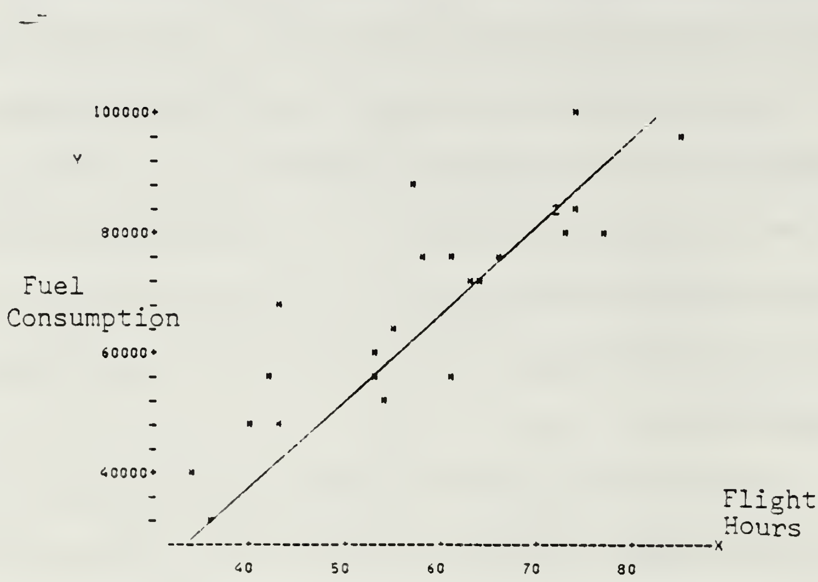


Figure 2
F14 Fuel Consumption Data

not model. Appendix E contains sample spreadsheets for both fuel and parts for the P3 aircraft. These data were then entered into a statistical analysis program, MINITAB.

Regression analysis was conducted separately for each type of aircraft. To eliminate the effects of inflation on the fuel information, all costs for each fiscal year were divided by the cost of fuel for that corresponding year. In order to minimize the impact due to a lag in accounting entries, all peaks and valleys were smoothed using moving averages. The moving averages method averages data for a few periods. For this study, data were grouped by fiscal year quarters and an average was calculated for each quarter. For example, all costs incurred in the first three months of the first quarter of the fiscal year were added together. This sum

was then divided by three, giving us a quarterly average. These calculations were made for all of the historical data entries.

The results of the regression analysis indicate, as expected, that there is a strong correlation between fuel consumed per hour by the aircraft and the actual flight hours. The regression equations and the results of the tests for significance are shown in Table 8.

TABLE 8

REGRESSION EQUATIONS AND THE TESTS FOR SIGNIFICANCE

	b	T test	m	T test	R^2	F test
A3	29729	3.03	650	3.38	$R^2 = 34.2\%$	11.43
A6	15845	1.37	669	2.83	$R^2 = 26.7\%$	8.02
A7	−353	0.08	680	4.63	$R^2 = 49.3\%$	21.42
F4	6869	0.65	1086	4.42	$R^2 = 47\%$	19.50
F14	5110	0.66	1080	8.42	$R^2 = 76.3\%$	70.89
F18	13394	2.43	525	2.13	$R^2 = 20.1\%$	4.53
H46	586	0.11	150	2.93	$R^2 = 28.1\%$	8.59
C12	−1658	0.74	111	4.22	$R^2 = 44.7\%$	17.78
P3	39827	1.19	906	5.29	$R^2 = 56\%$	27.95

In column b we find the value of the constant of the equations. Next to column b are the results of the T test for these constants. Except for two aircraft, the A3 and the F18, the constants can be considered statistically insignificant. The T test for the constant of the F18 fuel equation shows that the constant is important in explaining the dependent variable. This is probably due to the limited amount of data available for this analysis on this aircraft. The F18 has only been

assigned to PMTC since August 1985. There is no know reason why the T test for the constant is high in the A3 aircraft fuel consumption equation.

In column m, the value for the coefficient of the equations, the slope, are listed. The T test for the slope of each line indicates that the slope is a significant factor in explaining the dependent variable (y). The two tests of the regression line, R^2 and the F test, show that the equations are also statistically significant.

The results of the T test for the constant of the equation are extremely important to this analysis. Because most of the constants are of little statistical significance they can be eliminated for the regression equations. This allows us to use a special feature of the statistical package. The constant of the equation can be discarded and the final outcome is simply the coefficient of the equation, the rate per hour flown. These results are tabulated in Table 9.

TABLE 9

FUEL RATE FOR AIRCRAFT AT PMTC

Type Aircraft	Fuel Rate
A3	1200
A6	985
A7	707
F4	1243
F14	1163
F18	1070
H46	155
C12	92
P3	708

3. Regression Analysis of Parts Costs

Again, six years of monthly financial data for parts were analyzed. In this instance, only eight regressions were done. The C-12 is not included because parts for this aircraft are paid for under a fixed price contract. The six years of cost information for the aircraft parts were also entered into a Lotus 123 spreadsheet. The data were converted into constant dollars to suppress the effects of inflation. Moving averages were used here as well, to smooth the data. All of these data points were entered into the statistical analysis package.

Based upon PMTC's historical information for parts, no strong correlation could be found to flight hours. The conclusion that must be drawn is that parts are not related to flight hours and must be considered a fixed cost for rate setting purposes. Figure 3 aptly illustrates this conclusion. As can be seen, for any change in flight hours (x), no generalizations can be made about the effect the change may have on parts costs (y). Parts costs are constant, they are best described by a line with zero slope.

In lieu of a rate per hour for parts, the next best option to use in building the FHR model is the mean or average of the historical cost information. This mean will be used for the FHR calculations.

B. FIXED COSTS ANALYSIS

The Pacific Missile Test Center's fixed costs are primarily labor costs. There are two possible alternatives for distributing fixed costs. These alternatives are total costs input and one factor of operation, both of these concepts were discussed earlier in Chapter III under the section entitled Cost Allocation. Under one factor of operation we have two choices: flight hours or labor hours. Labor hours have been selected as the most relevant means of distributing fixed cost because labor

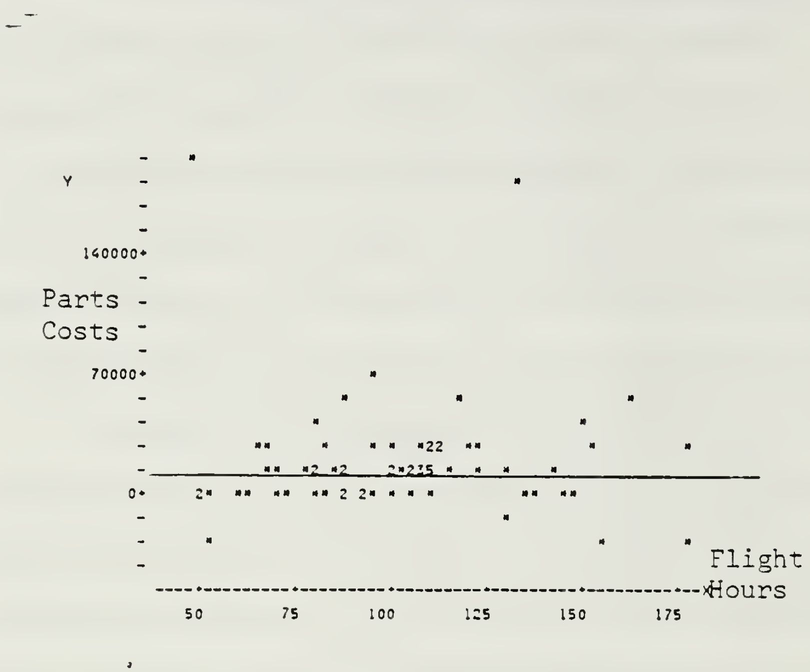


Figure 3.
H46 Parts Cost Data

costs are the greatest share of total fixed costs. The choice has also been made to adopt the fixed cost equations used by NWC. There are three advantages in using NWC's method. The advantages are that 1) labor hours are directly associated with the fixed costs incurred, 2) NWC's formulas are easy to understand, explain and use and 3) there is a Comptroller of the Navy requirement to use labor hours (Ref. 5). However, there is one disadvantage. The Naval Weapons Center method relies heavily on fleet maintenance manhour information. For aircraft that are newly assigned to the fleet there may be a marked learning curve, which will be reflected in the maintenance manhours required to support the aircraft. This learning curve phenomenon is temporary however lasting only until the technicians become thoroughly familiar with the new aircraft.

The Naval Weapons Center equations for disbursement of fixed costs are reintroduced below.

1. First, MMH/FH for each type aircraft are multiplied by the projected FH for that aircraft (Ref. 10). For example, for the A7 aircraft, the first equation might be:

$$70 \text{ MMH/FH } \times \text{ } 300 \text{ FH } = 21,000 \text{ TOTAL MMH}$$

2. Next, all maintenance costs, less fuel, are divided by the total MMH for all aircraft. To arrive at the MMH for all aircraft, the 21,000 total MMH for the A7 is added to the total MMH for all of the other assigned aircraft. In our example, this total is 280,000 MMH for all aircraft. From this division we get the MMH rate:

$$\frac{\$7,000,000 \text{ MAINT COSTS ALL AIRCRAFT}}{280,000 \text{ MMH ALL AIRCRAFT}} = \$25 \text{ MMH RATE}$$

3. This MMH rate is multiplied by the MMH/FH for each type of aircraft to derive the maintenance costs per hour for that aircraft. For our example A7:

$$\$25 \text{ MMH RATE } \times 70 \text{ MMH/FH } = \$1750 \text{ MAINT COST/HR}$$

This derived maintenance cost per hour is added to the variable rate (fuel) to compute the final FHR. This method adds part costs to fixed costs in order to determine the maintenance cost per hour. The alternative proposed herein will treat parts costs in a slightly different manner.

In summary, the variable costs analysis gave us the first two pieces of information needed to begin the construction of the new FHR models. A fuel rate per aircraft was found. Parts, it was concluded, had to be considered fixed and the six year mean used in the new FHR equations. The Naval Weapon Center's formula was selected as the best way to apportion fixed costs. The actual construction of the new FHR's can now begin.

C. THE ALTERNATIVE AIRCRAFT FLIGHT HOUR RATE

Before the Lotus 123 spreadsheet can be built, FY 88 data must be gathered. This information includes such items as the price of fuel for FY 88, proposed flight hours (project and non-project), fixed cost information, etc.

The full spreadsheet for these new FHR's can be found in Table 10.

The spreadsheet begins with each type aircraft.

- columns 2-4 list the flight hours to be flown for the entire fiscal year.
- columns 5-8 are dedicated to calculating the fuel costs for the aircraft.
- columns 9-11 compute the parts costs.
- columns 12-16 list the costs to be normalized.
- columns 17-20 contain the formulas necessary for the normalization of the fixed costs. Column twenty represents the actual share by type aircraft for the total normalized costs.
- column 21 is a summation of fuel, parts and the normalized costs for each type aircraft.
- column 22 contains the proposed aircraft flight hour rates for FY 88.

D. CONCLUSION

In summary, we have developed a new model for each aircraft flight hour rate. These models are based upon six years of cost information. Regression analysis has been used as a tool to derive the rate per hour flown for the variable cost part of the FHR equation. We have used a computerized spreadsheet to store the data and, given the appropriate formulas, we have used the spreadsheet to calculate the FHR for the aircraft. There are many advantages in using a computerized system such as the one detail in the next chapter, the Decision Support System.

TABLE 10

PMTC AIRCRAFT FHR'S FOR FY 88

1	2	3	4	5	6	7	8
ACFT	TRAIN HRS	PROJ HRS	TOTAL HRS 88	FUEL USE GAL/HR	FUEL RATE COST/GAL	FUEL COST FOR FY 88	FOR FY 88
A-3	130	140	270	1200	0.68	816	220,320
A-6	25	50	75	985	0.68	670	50,235
A-7	150	350	500	707	0.68	481	240,380
F-4	90	210	300	1243	0.68	845	253,572
F-14	130	520	650	1163	0.68	791	514,046
H-46	648	252	900	155	0.68	728	94,860
C-12	572	528	1100	92	0.68	63	68,816
P- 3	400	1850	2250	708	0.68	481	1,083,240
	2258	4238	6496				2,853,617

1	9	10	11
ACFT	PARTS	INFLATION FACTOR	PARTS COST
A-3	58560	1.13	66,173
A-6	64952	1.13	73,396
A-7	27532	1.13	31,111
F-4	35172	1.13	39,744
F-14	149996	1.13	169,495
F-18	138732	1.13	156,767
H-46	76968	1.13	86,974
C-12	BASI CONTRACT		210,000
P-3	149578	1.13	169,023
			1,002,684

TABLE 10 Continued

1	12		13	14	15	16	
ACFT	LABOR COSTS		GSE COSTS	LEVEL 2 COSTS	TRAIN COSTS	COSTS TO BE NORMALIZED	
A-3							
A-6	CIVILIANS	87	1,224,000				
A-7	CONTRACTOR						
F-4	GTSI	81	2,481,300				
F-14	GAC	33	2,275,000				
F-18	HAC	5	425,000				
H-46	MCAIR	3	265,000				
C-12							
P-3							
			6,670,300	1,797,367	686,237	80949	9,153,904

1	N	17	18	19	20	21	22
ACFT	O	MMH	TOTAL	MMM	NORM	TOTAL	FHR
	R		MMH	RATE	SHARE	COSTS	PROPOSED
	R						
	M						
A-3	A	56	15120		720608.3	1,007,101	3,730
A-6	L	55.5	4162.5		198381.7	322,013	4,294
A-7	I	38.5	19250		917441.1	1,188,932	2,378
F-4	Z	43.5	13050		621953.6	915,270	3,051
F-14	A	58.8	38220		1821537.	2,505,079	3,854
F-18	T	27.2	12267.2		584645.9	1,069,561	2,371
H-46	I	25.5	22950		1093780.	1,275,614	1,417
C-12	O	0	0			278,816	253
P-3	N	29.8	67050		3195554.	4,447,818	1,977
			192,070	47.65928	9153904	13,010,204	

V. THE DECISION SUPPORT SYSTEM

A decision support system (DSS) is a tool which can be used by management to effect better planning and control. A DSS supports the decision making process. Much of the information gathered for this study and the systems developed as a result of the flight hour rate analysis can be used as part of a DSS for the management of the aircraft flight hour account at the Pacific Missile Test Center (PMTC).

Once in place, the DSS is intended to serve three functions. First, it facilitates the aircraft flight hour rate (FHR) calculations. Secondly, the DSS, through the spreadsheet, becomes a budget, a device to be used to conduct cost and schedule variance analysis. Lastly, the DSS improves the allocation of scarce resources.

This DSS consists of the Lotus 123 spreadsheets and historical information compiled from PMTC financial and administrative records.

A. THE DSS AND AIRCRAFT FLIGHT HOUR RATE CALCULATIONS

The spreadsheets enable the quick and accurate computation of the FHR's. Chapter IV explained at length how the aircraft FHR's are calculated. However, an integral part of the calculated rate is the proposed level of activity or flight hours. How to predict flight hours has yet to be discussed. Accurately forecasting flight hours is important because fixed costs are disbursed over the aggregate of flight hours. If the predictions are too high and not enough hours are flown, there will be a revenue shortfall. If the hours are set too low, too much revenue will be generated and the customer will have paid too much to fly the aircraft. The

customer, the program office, seeks to make maximum use of every available dollar and can be frustrated when over-charged.

1. Forecasting Aircraft Flight Hours

There are two basic types of forecasting methods available for management planning and decision making. The first type of forecasting is quantitative forecasting. Quantitative forecasting uses mathematical models or equations to predict the future based upon past data patterns. Quantitative forecasting has not been used in this study to forecast flight hours, however, it should be mentioned as an option for management planning.

The second method, qualitative forecasting, is subjective and includes such techniques as surveys, the delphi method, executive committee consensus and forecasting based on historical information. Qualitative forecasting is possible here through the use of the historical information provided in Appendix A, which contains five years of information on flight hours, both for project and training hours. The historical information serves as a bench mark, a reference point. The historical information tells us what has been feasible in the past and guides us to what may be achievable in the future. Historical information makes systematic forecasting possible. From these historical records, activity capacity levels can be observed. During the last five years, all of the aircraft at PMTC have flown less than 5,200 project flight hours, averaging 4,400 project hours per fiscal year. These hours may represent a constraint. It could very well be that the number of aircrew personnel assigned limits the flight hours flown on the aircraft. Access to controlled airspace, with telemetry support, may also be a restricting factor.

Congressional actions should also be kept in mind when flight hours are forecasted. The Department of Defense is facing increasing cuts in appropriations; these cuts may affect how much the program offices in Washington can afford to

spend on research, development, test and evaluation of aircraft systems. Each of the examples cited here are matters which can be addressed via the qualitative forecasting technique.

2. Benefits of the Aircraft FHR Spreadsheet

Quick and correct calculation of the aircraft FHR is not the only advantage provided by this computerized system. Another advantage is that interested personnel can easily comprehend how the FHR's are computed. Sharing information such as this is vital. Greater understanding of how the system works and how decisions are made, can lead to improved communications within an organization and can build trust among management personnel.

An additional benefit to be derived is that each of the aircraft FHR's can now be broken down into identifiable parts and special flight hour rates can be set for unique circumstances. For example, an aircraft may be assigned to PMTC with a special labor contingent. In this instance, all labor costs in the FHR should be dropped and only fuel and parts should be charged to the user of the aircraft.

B. THE DSS: COST CONTROLS AND PERFORMANCE TRACKING

The spreadsheet, which was used to compute the aircraft FHR, includes a whole fiscal year of cost information. This information can serve as a budget, a framework through which actual performance can be measured. The aircraft flight hours can be broken down and a budget set for each quarter. Appendix F contains an example of a quarterly budget. Using these quarterly budgets, the maintenance manager can compare actual costs and performance to planned or budgeted costs. Costs and schedule variance analysis can be used to track the effectiveness of the established aircraft FHR. Section A3 in Chapter III discusses cost and schedule variance analysis in detail.

Throughout the year the maintenance manager can use this DSS to make timely decisions on whether or not the rates being charged to the customer are accurate and whether or not they need to be adjusted to reflect actual cost and schedule performance.

The maintenance manager can also identify aberrations in support costs. These unusual costs can be pinpointed and isolated, then steps can be taken to correct any deficiencies.

3. The DSS and Resource Allocation

The DSS is a labor saving device; it frees personnel from mundane arithmetic calculations and allows them to use their time more productively on analysis and planning. Also, through the DSS, capital resources can be more efficiently utilized. As we have seen, aircraft flight hours can be better forecasted, improving aircraft utilization. Training and program funds can be apportioned in the most efficient way possible. This decision support system incorporates sensitivity information to help management quantify the impact of different strategic decisions, in order to find the optimum level of resource utilization.

Sensitivity analysis is, in layman's terms, what-if analysis. This DSS allows the decision-maker to pose questions and, by manipulating the data, get instantaneous results. Flight hours can be changed in the Lotus 123 spreadsheet and the effects on revenues can be measured. Costs can be increased or decreased and the impact on the FHR can be immediately assessed. At the end of the spreadsheet there is a what-if section, displayed in Table 11 below. The formulas in the program have been constructed so that changes made to this one section alone will update the whole spreadsheet. For example, should there be a requirement to train additional pilots on the A3 aircraft, the decision-maker need only enter the new flight hours in column 23 below. This entry will automatically update columns 27

(training revenue), 29 (total revenue) and 30 (total costs). This capability is especially useful in a group decision making setting, such as the Aircraft Requirements Board (ARB). If the reader will recall, the ARB is the body at PMTC which is entrusted with recommending aircraft FHR's to the Commander, Pacific Missile Test Center.

TABLE 11

AIRCRAFT FHR SENSITIVITY ANALYSIS

1	23	24	25	26	27	28	29	30
ACFT	TRAIN HRS	PROJ HRS	TOTAL HRS	FHR WHAT-IF	TRAIN REVENUE	PROJ REVENUE	TOTAL COSTS	TOTAL
A-3	130	140	270	3800	494,000	532,000	1,026,000	1,007,101
A-6	25	50	75	3800	95,000	190,000	285,000	322,013
A-7	150	350	500	2200	330,000	770,000	1,100,000	1,188,932
F-4	90	210	300	3800	342,000	798,000	1,140,000	915,270
F-14	130	520	650	4000	520,000	2,080,000	2,600,000	2,505,079
F-18	113	338	451	2600	293,800	878,800	1,172,600	1,069,561
H-46	648	252	900	1100	712,800	277,200	990,000	1,275,614
C-12	572	528	1100	300	171,600	158,400	330,000	278,816
P-3	400	1850	2250	2100	840,000	3,885,000	4,725,000	4,447,818
	2258	4238	6496		3,799,200	9,569,400	13,368,600	13,010,204

TOTAL TRAINING FUNDS RECEIVED: 5,541,000

Management goals or targets can be set and, through sensitivity analysis, the decision maker can maximize available resources. A target in this goal seeking process would be to make the revenue level (column 29) match the total projected costs (column 30). Another area, which should be watched is the funds which

have been provided for aircrew training. The total cost for all the hours flown on training flights (column 27) should equal the funds provided (below column 27).

In conclusion, this DSS serves management in a variety of ways. The decision support system improves cost control and forecasting. The decision support system assists management in making correct decisions for resource allocation. And, finally, the DSS can increase confidence and trust within the organization as the decision-making process becomes a comprehensible and collaborative effort.

VI. CONCLUSION

One of the objectives of this study has been to use the computer to automate manual procedures currently employed by the Pacific Missile Test Center (PMTC) to calculate the aircraft flight hour rate (FHR) and to manage the aircraft holding account. This objective has been realized through the development of the proposed decision support system (DSS), as discussed in chapters IV and V of this study.

The future holds a lot more automation in sight for PMTC. In the coming fiscal year, a Department of Defense (DOD)-wide computer automated cost accounting system will be coming on line for all Navy Industrial Fund activities. The purpose of this system, the Standard Automated Financial System (STAFS), is to "provide a structure for accruing, distributing and reporting costs related to the operation of aircraft." (Ref. 12) This system will automatically provide all reports required by higher authority. This system will free Comptroller personnel of these time consuming tasks and they will become available to provide greater in-house support to the analysis of the aircraft holding account.

A. RECOMMENDATIONS

Presently PMTC does not use a budget to manage the aircraft support and operation costs. It is highly recommended that the spreadsheet, which was developed in Chapter IV, be implemented as a budget. With a budget, actual costs vs estimated costs can be analyzed. Cost and schedule variance analysis can be performed. Negative patterns can be discerned with this system and action can be taken to bring these adverse trends back in line.

It is also recommended that more automation be implemented to manage this account. The capability exists at PMTC to tie desktop computers into the mainframe computer. Programs can be written to pull data directly out of the mainframe into the Lotus 123 program, thereby updating, at the push of a button, the aircraft account ledgers.

Another recommendation is that the Comptroller change the way the variance is being calculated between the established aircraft FHR and the actual rate. Presently, flight hours are being used as a means of distributing actual fixed costs. These fixed costs are being compared to costs which were allocated based upon labor hours. This is an erroneous comparison. The fixed costs should be distributed in the same manner, for both the actual and the established flight hour rates. Only then can the variance between these two rates have any true meaning.

Also, the Comptroller should whenever possible use equations that can be easily understood. The equations that are currently used to brief command personnel are confusing and can only confound those involved in the decision-making process.

B. FOLLOW-ON ANALYSIS

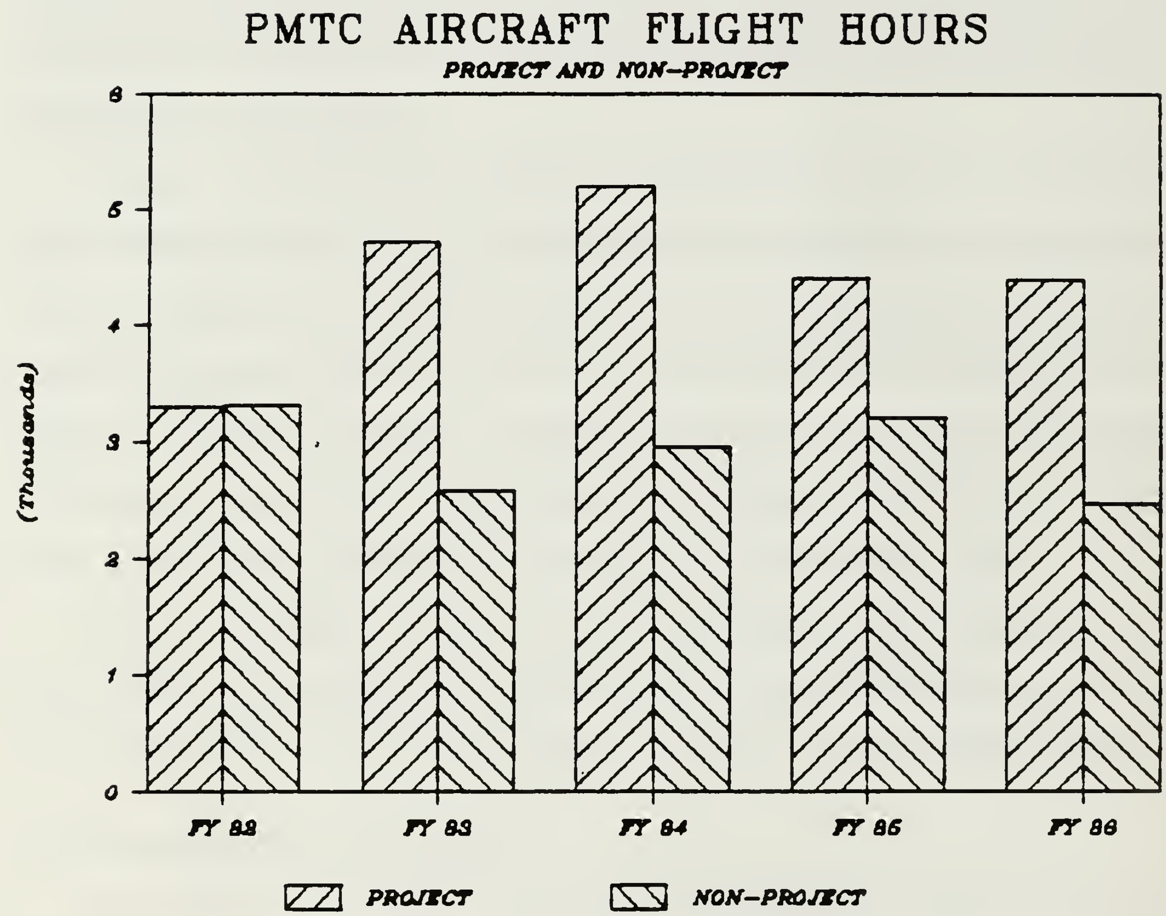
The discovery that parts cost for aircraft flying are not variable but fixed is significant. Under the current budget system, the U. S. Navy requests funds from Congress for aircraft flying based upon a part rate per hour flown (Ref. 13). The fact that no corrleation could be made in this analysis between flight hours and parts costs needs to be pursued further.

It is recommended that a follow-on study be undertaken to confirm this finding. Perhaps the most appropriate means to continue this analysis would be to gather

historical cost information from the entire fleet for one or more aircraft, and to apply statistical techniques similar to the ones used in this study.

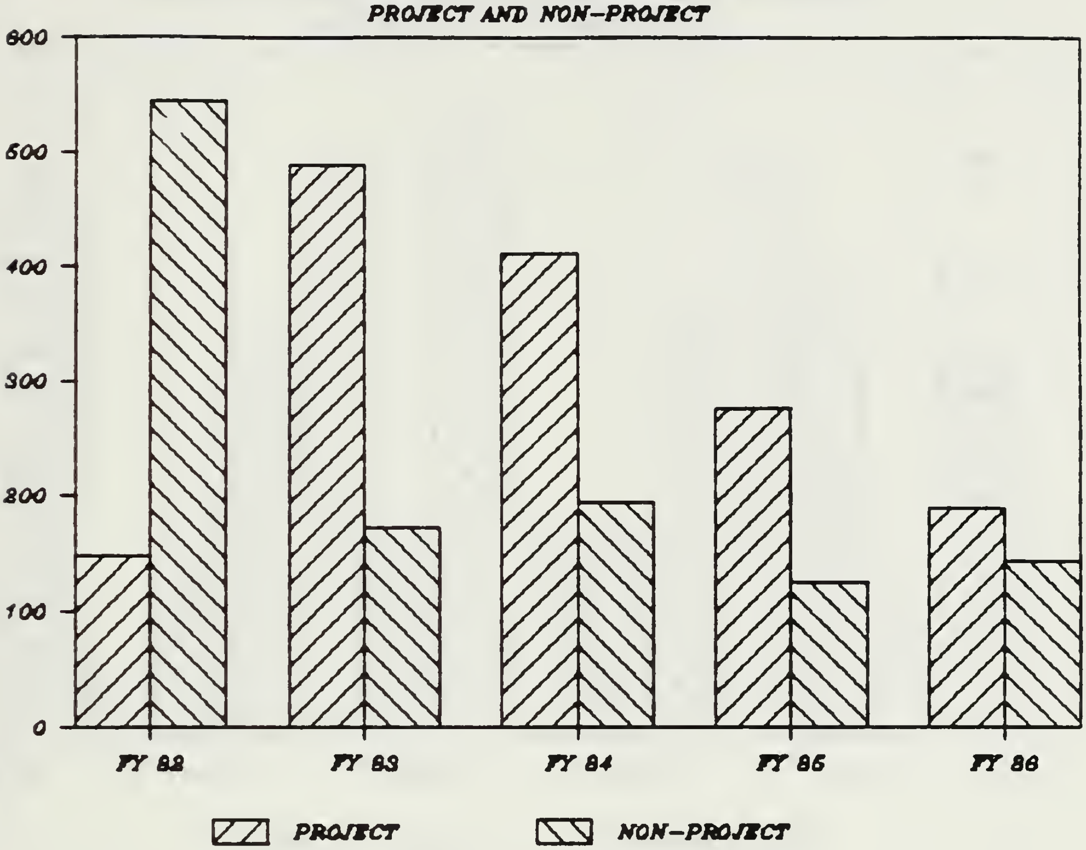
APPENDIX A

HISTORICAL FLIGHT DATA

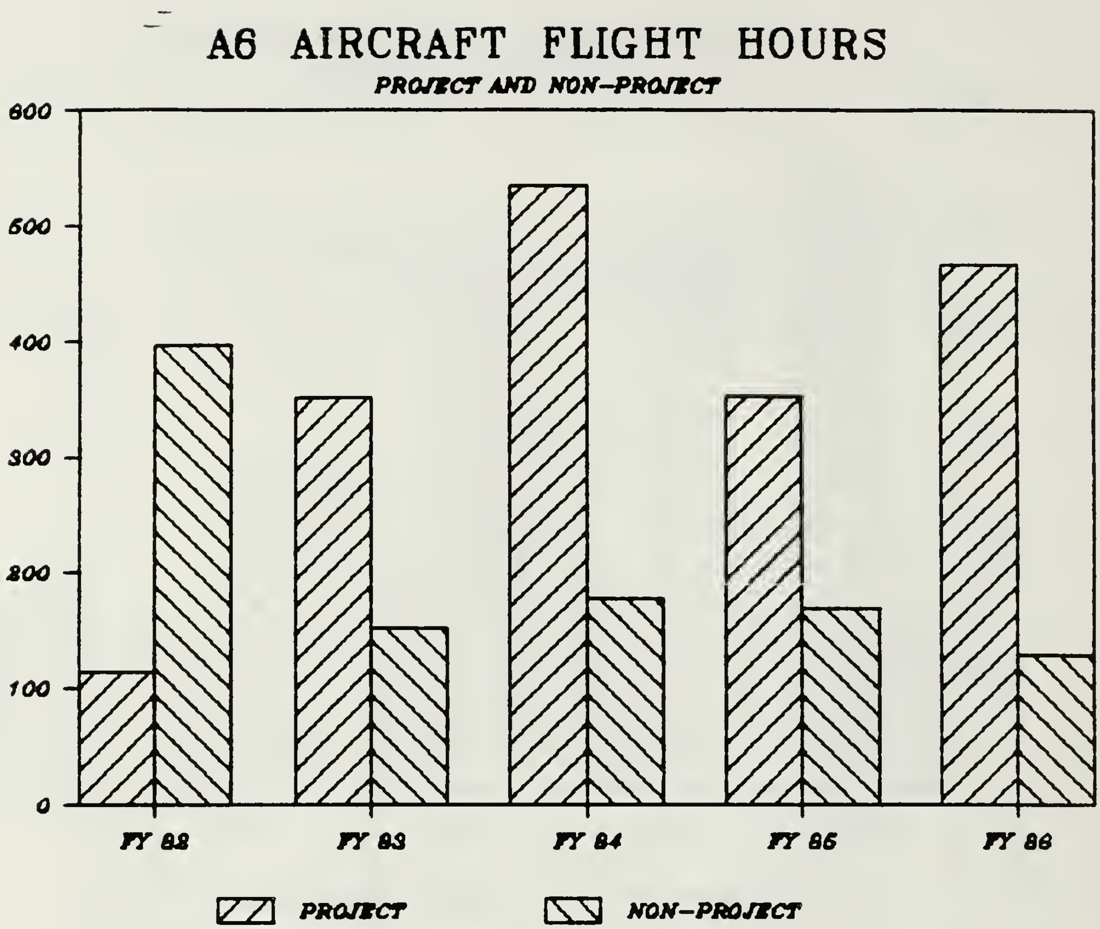


	PROJ	NON-PROJ
FY 82	3303	3316.8
FY 83	4716.3	2576.9
FY 84	5204.3	2958.4
FY 85	4412	3213.9
FY 86	4392	2469.6

A3 AIRCRAFT FLIGHT HOURS

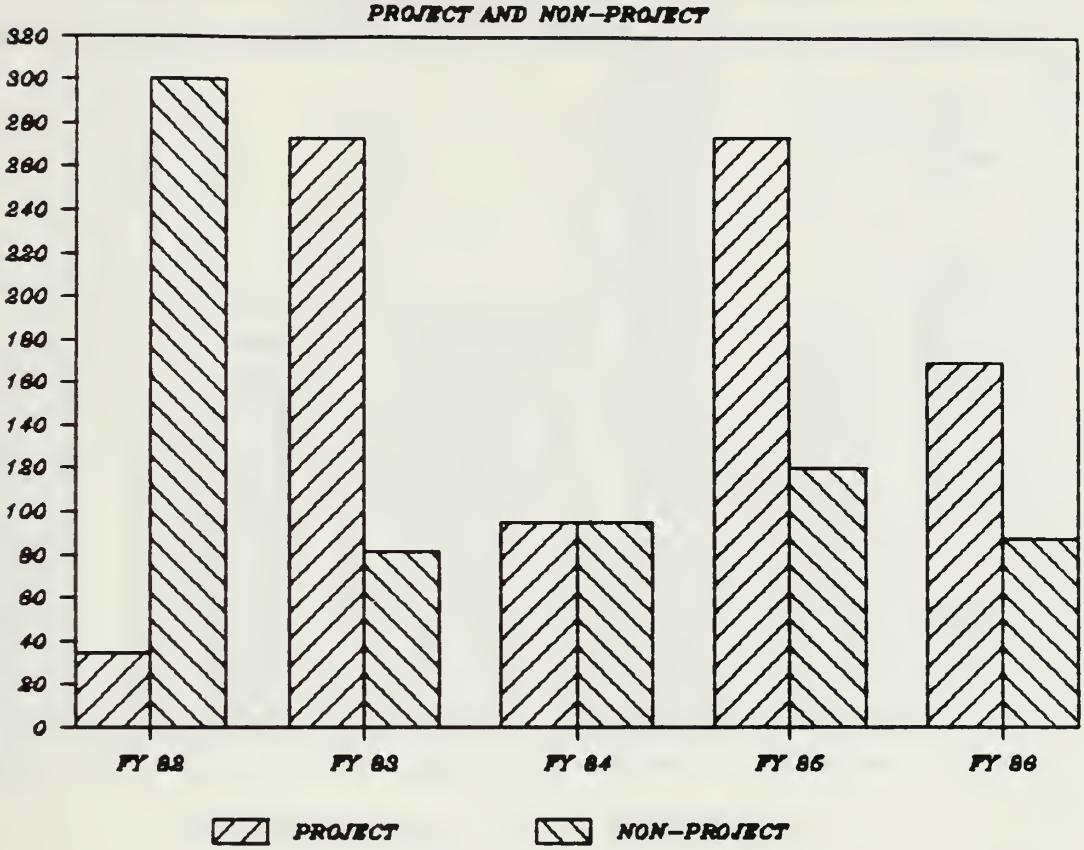


	PROJ	NON-PROJ
FY 82	148.2	544.2
FY 83	488.7	173.2
FY 84	411.7	195
FY 85	276.9	126
FY 86	190.2	143.9



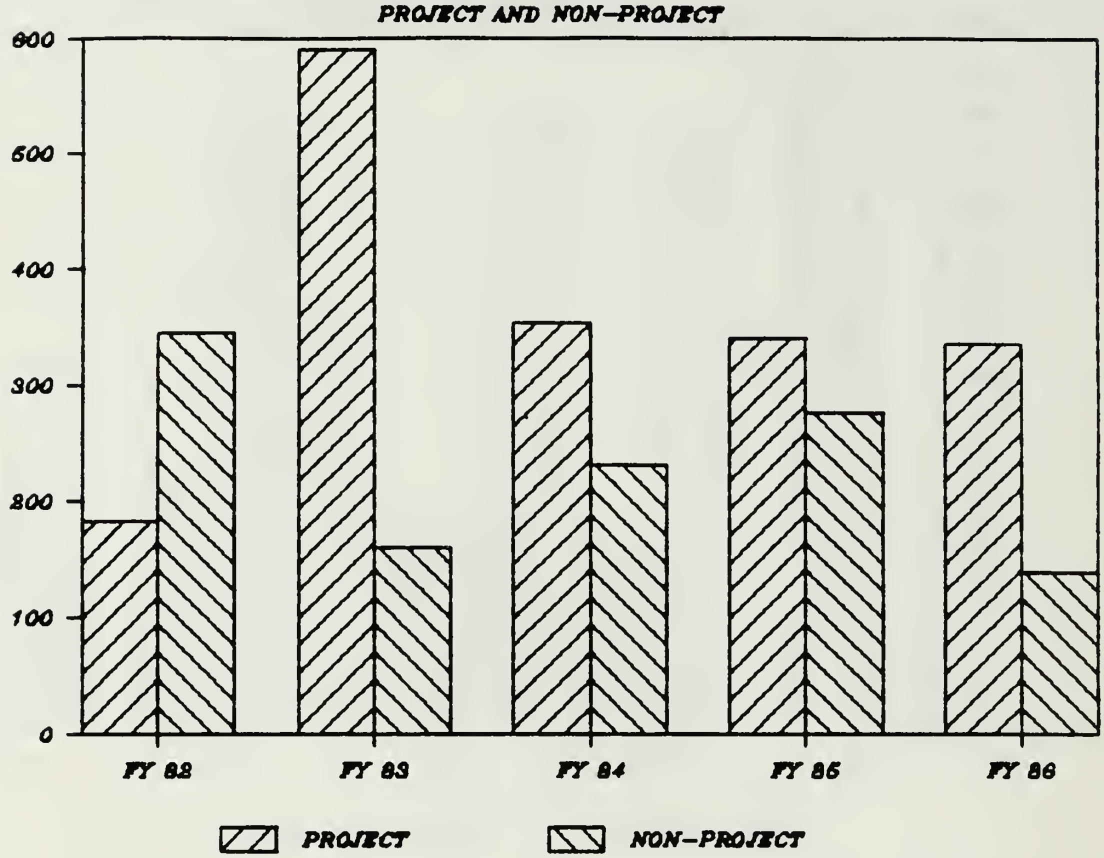
	PROJ	NON-PROJ
FY 82	113.9	397.1
FY 83	351.9	152.5
FY 84	534.5	177.6
FY 85	353	168.9
FY 86	467.3	128.3

A7 AIRCRAFT FLIGHT HOURS



	PROJ	NON-PROJ
FY 82	34.7	300.2
FY 83	273.2	82
FY 84	94.9	94.9
FY 85	273.8	120.2
FY 86	169.7	87.6

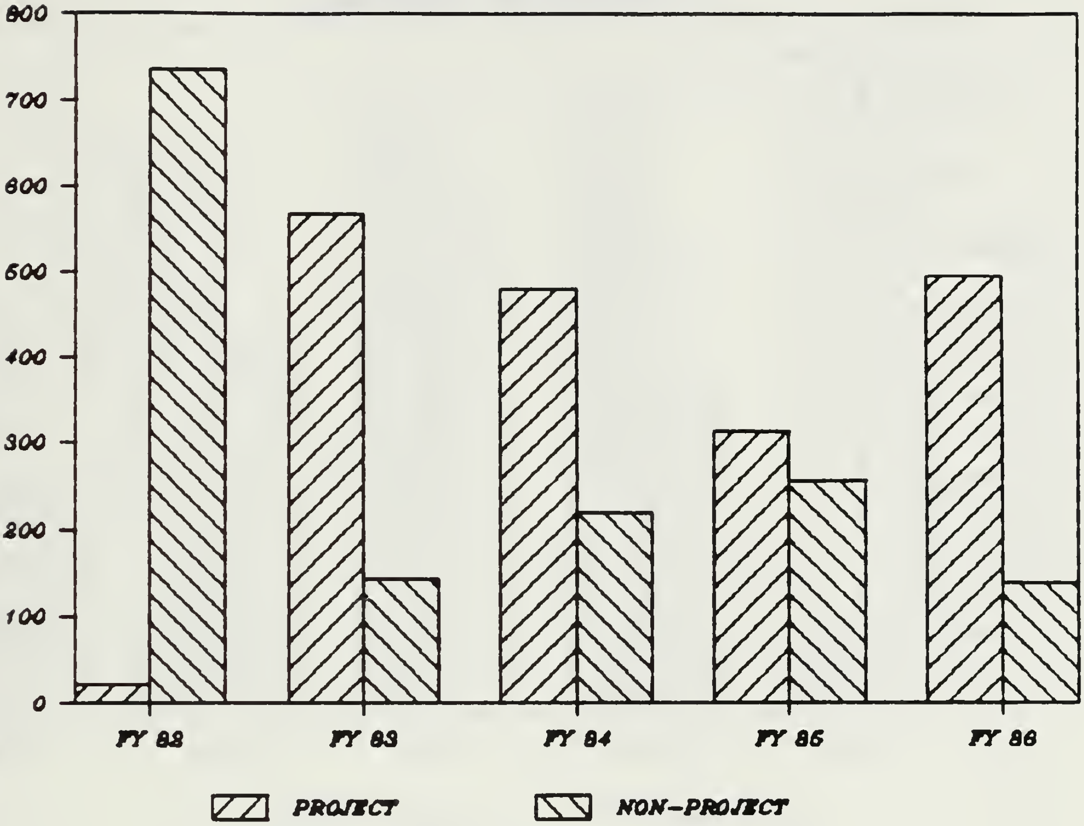
F4 AIRCRAFT FLIGHT HOURS



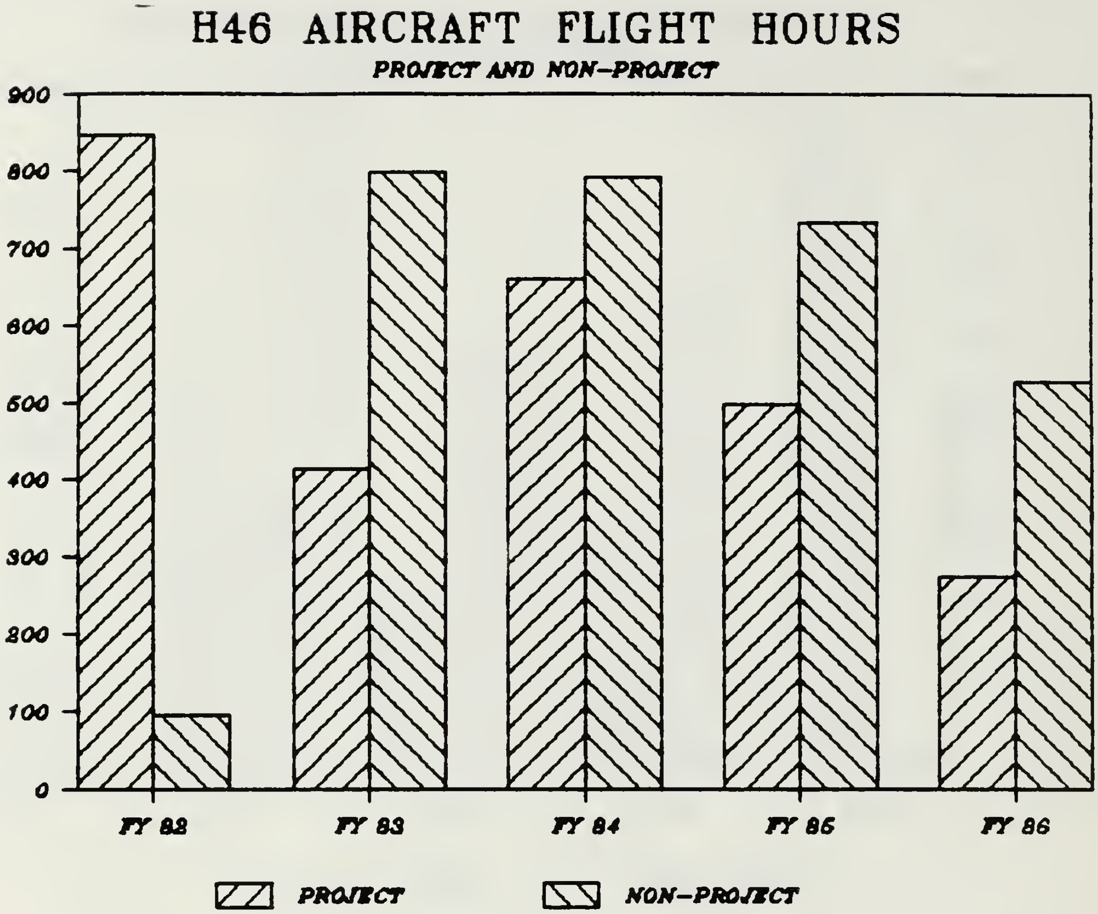
	PROJ	NON-PROJ
FY 82	182.9	345.9
FY 83	590.2	160.2
FY 84	354.3	232
FY 85	341	276.4
FY 86	336	139.4

F14 AIRCRAFT FLIGHT HOURS

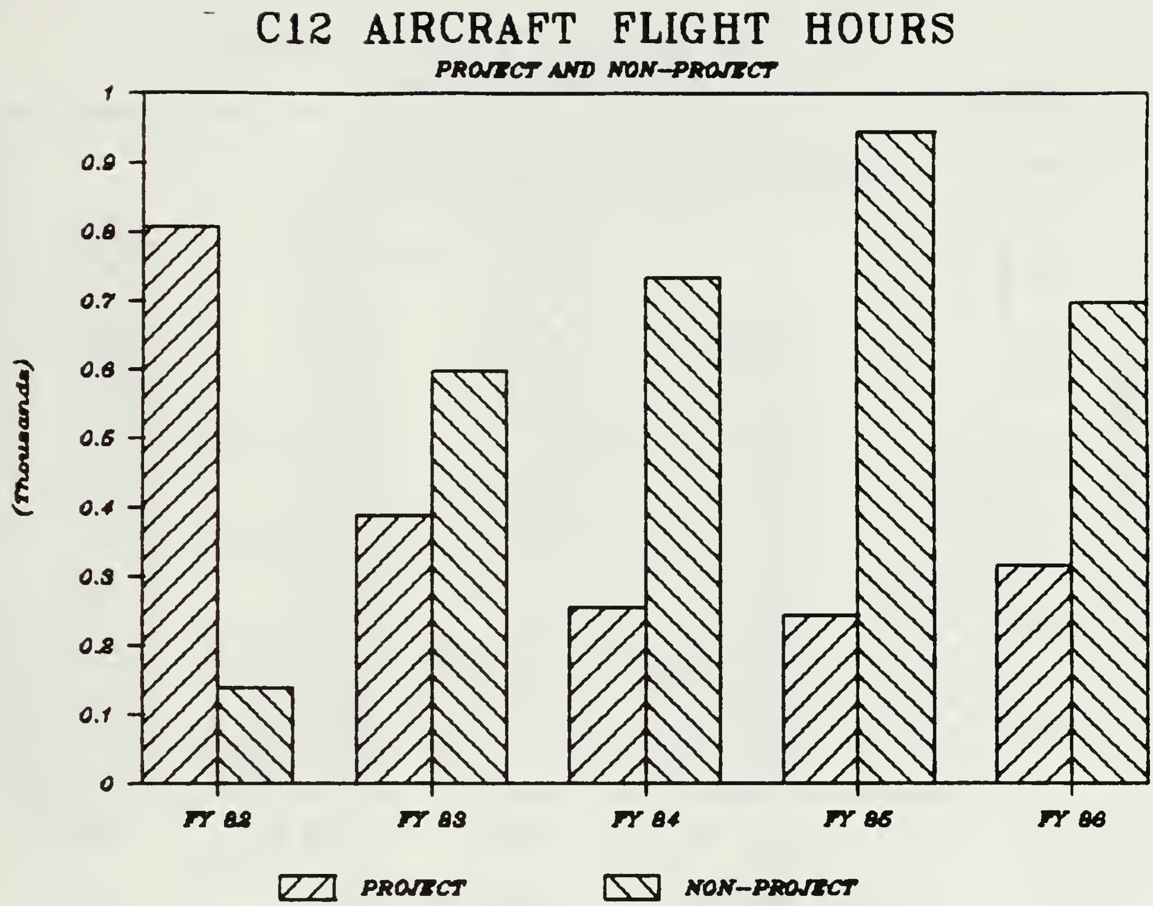
PROJECT AND NON-PROJECT



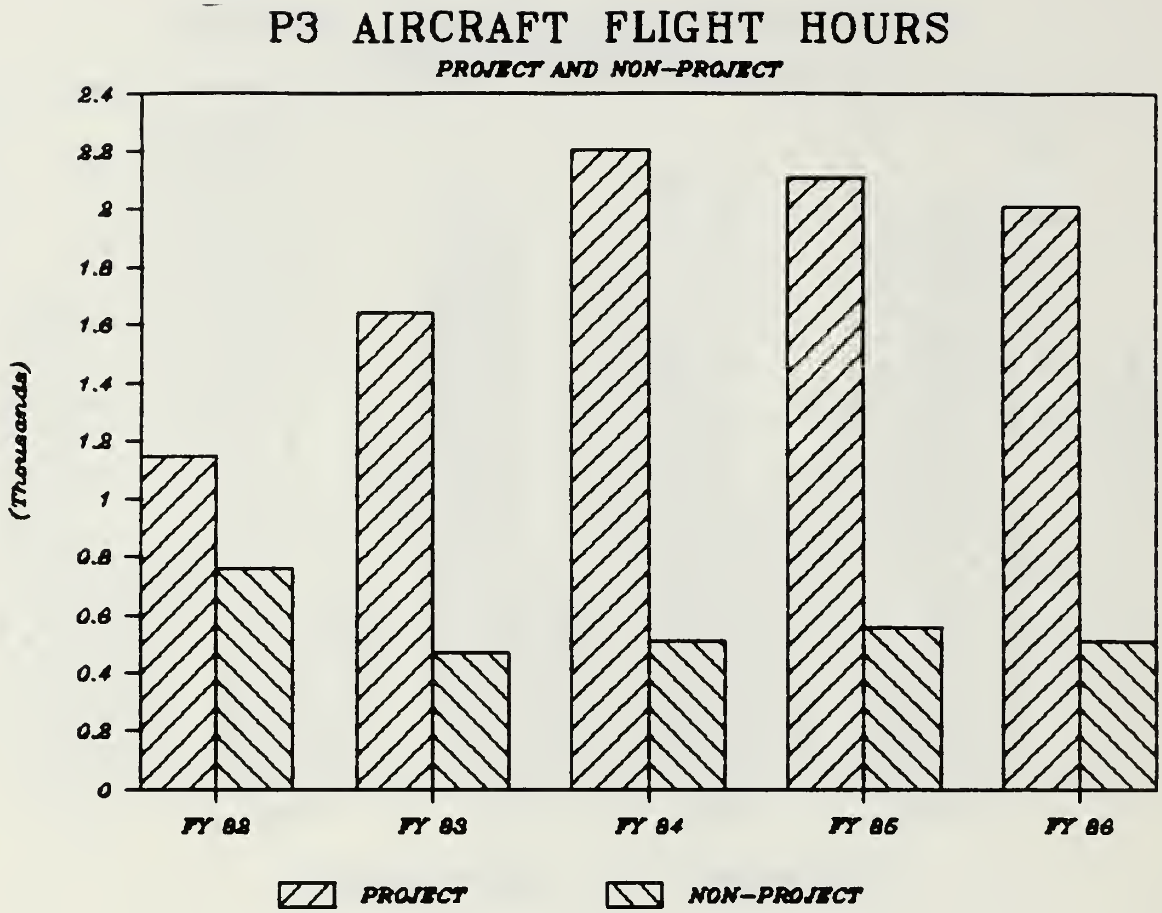
	PROJ	NON-PROJ
FY 82	21.5	735.6
FY 83	568.4	142.7
FY 84	480.1	219.6
FY 85	312.4	255.9
FY 86	495.4	138.3



	PROJ	NON-PROJ
FY 82	845.4	95.5
FY 83	414.3	799.7
FY 84	660.7	793
FY 85	499.4	733.7
FY 86	275	528.8



	PROJ	NON-PROJ
FY 82	808.6	138.2
FY 83	387.8	597.8
FY 84	256.4	734.3
FY 85	244	944
FY 86	316.3	697.5



	PROJ	NON-PROJ
FY 82	1147.8	760.1
FY 83	1641.8	468.8
FY 84	2203.9	512
FY 85	2110.2	555.6
FY 86	2010.6	511.3

APPENDIX B

AIRCRAFT FHR HISTORIES
PMTC AIRCRAFT FHR HISTORY

A3

FY81		2300
FY82		2675
	Jan 82	3435
	May 82	3200
FY83		2850
	Feb 83	3100
	May 83	3450
FY84		3400
	Jun 84	2800
	Aug 84	1867
FY85		3200
	Jun 85	3500
	Aug 85	4185
FY86		4000
	May 86	4810
FY87		4740
	May 87	3800

A6

FY81		2,000
FY82		2320
	Jan 82	4040
	May 82	3400
FY83		3425
	Feb 83	3750
	May 83	4170
FY84		3900
	Jun 84	3200
	Aug 89	2133
FY 85		3140
	Jun 85	3400
	Aug 85	4065
FY86		4000
	May 86	4810
FY87		4600
	May 87	3800

A7

FY81		1370
FY82		1420
	Jan 82	2065
FY83		2150
	Feb 83	2300
	May 83	2550
FY84		2500
	Jun 84	2000
	Aug 84	1333
FY85		2350
	Jun 85	2700

F4

FY81		4100
FY82		4300
	May 82	4450
FY83		4000
	Feb 83	4100
	May 83	4550
FY84		4100
	Jun 84	3600
	Aug 89	2400
FY85		3600
	Jun 85	3800

	Aug 85	3230
FY86		3000
	May 86	3400
FY87		3000
	Nov 86	2800
	May 87	2200

	Aug 85	4540
FY86		4000
	May 86	4500
FY87		4000
	Nov 86	4300
	May 87	3800

F14

FY81		3700
	Apr 81	6700
FY82		7960
	Jan 82	6685
	May 82	6350
FY83		6150
	Feb 83	4400
	May 83	4900
FY84		4400
	Jun 84	3700
	Aug 84	2467
FY85		3795
	Jun 85	4100
	Aug 85	4900
FY86		4500
	May 86	5100
FY87		5250
	May 87	4000

H-46

FY81		1325
	Apr 81	1150
	Jul 81	1000
FY82		1200
	Jul 82	1050
FY83		1200
	Feb 83	1300
FY84		1300
	Jun 84	1050
	Aug 84	700
FY85		1310
	Jun 85	1400
	Aug 85	1675
FY86		1500
FY87		1800
	Nov 86	1500
	May 87	1100

UC-12

FY81		175
	Apr 81	150
	Sep 81	175
FY82		150
FY83		150
	Feb 83	250
FY84		285
FY85		255

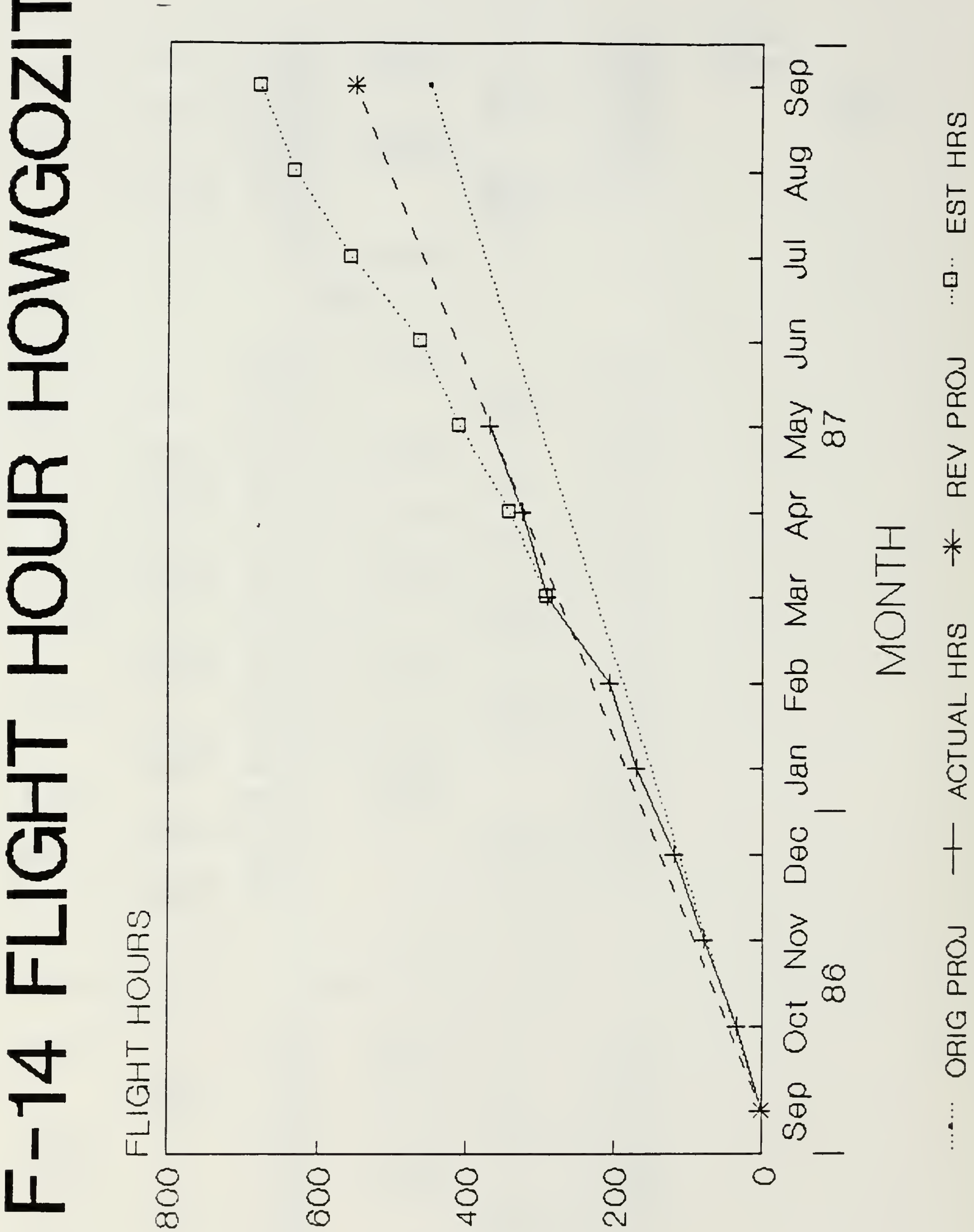
P-3

FY81		1600
	Jul 81	1800
FY82		2050
	May 82	2100
FY83		2200
	Feb 83	2250
	May 83	2500
FY84		2300

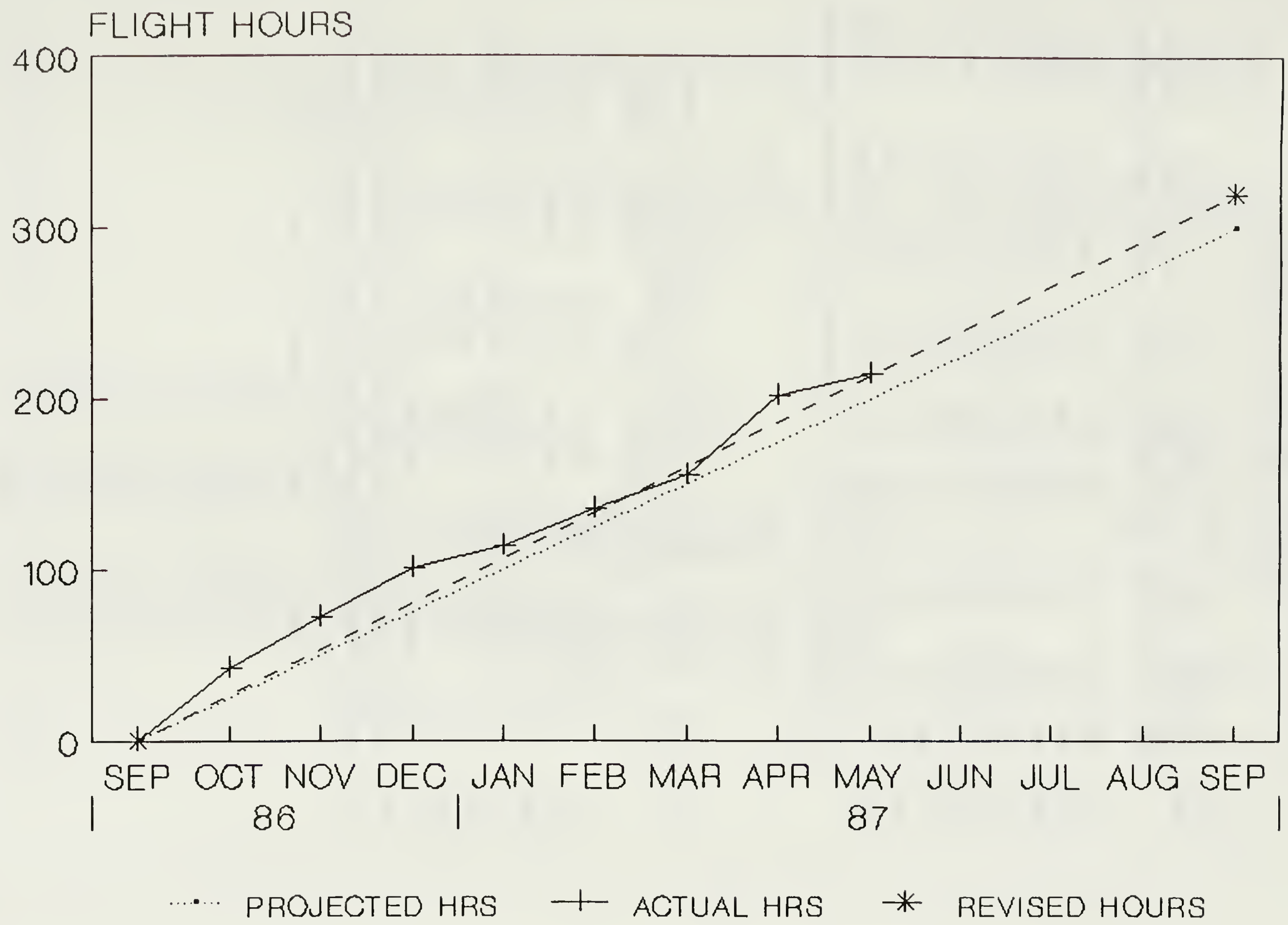
	Jun 85	270		Jun 84	1850
	Aug 85	325		Aug 84	1233
FY86		300	FY85		1940
FY87		300		Jun 85	2400
				Aug 85	2870
			FY86		2600
			FY87		2300
				May 87	1900

APPENDIX C

HOWGOZITS



A-6 FLIGHT HOUR HOWGOZIT



APPENDIX D

STRIKE AIRCRAFT TEST DIRECTORATE FLYING HOUR BUDGET

A ACFT	B INST HRS	C USER HRS	D TOTAL FY-87 HRS	E FUEL USE GAL/HR	F FUEL COST/GAL	G POL RATE	H FUEL COST BUDGET	I FUEL FACTOR	J FINAL FUEL COST BUDGET
A-4	733	375	1,108	560	0.79	442.4	490,179	1.00	490,179
A-6	144	360	504	918	0.79	725.2	365,511	1.00	365,511
EA-6B	44	72	116	939	0.79	741.8	86,050	1.00	86,050
A-7	211	765	976	635	0.79	501.7	489,610	1.00	489,610
AV-8	46	145	191	663	0.79	523.8	100,040	1.00	100,040
OV-10	24	80	104	121	0.79	95.6	9,941	1.00	9,941
F-4	262	575	837	1,489	0.79	1176.3	984,571	1.00	984,571
F-14	208	381	589	1,134	0.79	895.9	527,662	1.00	527,662
F-18	78	1,015	1,093	982	0.79	775.8	847,928	1.00	847,928
	1,750	3,768	5,518				3,901,492		3,901,492

A ACFT	K PARTS RATE	L PARTS COST	M PARTS FACTOR	N FINAL PARTS COST BUDGET	O DIR PARTS BUDGET	P AM PARTS BUDGET	Q SA VAR COST BUDGET
A-4	273	302,484	1.00	302,484	181,490	120,994	792,663
A-6	567	285,768	1.00	285,768	171,461	114,307	651,279
EA-6B	685	79,460	1.00	79,460	47,676	31,784	165,510
A-7	352	343,552	1.00	343,552	206,131	137,421	833,162
AV-8	256	48,896	1.00	48,896	29,338	19,558	148,936
OV-10	354	36,816	1.00	36,816	22,090	14,726	46,757
F-4	553	462,861	1.00	462,861	277,717	185,144	1,447,432
F-14	637	375,193	1.00	375,193	225,116	150,077	902,855
F-18	441	482,013	1.00	482,013	289,208	192,805	1,329,941
		2,417,043		2,417,043	1,450,226	966,817	6,318,535

A	R	S	T	U	V	W
ACFT	ACFT LABOR COST FACTOR	ACFT OVHD COST FACTOR	DIR SHARE TOT VAR COSTS	SA LABOR	BUDGET	TOT DIR LABOR COST
A-4	0.1255	0.1255				
A-6	0.1031	0.1031			# BUDGETED	COST
EA-6B	0.0262	0.0262		CIVILIANS	0.0	585,027
A-7	0.1319	0.1319		DYNA	130	4,533,360
AV-8	0.0236	0.0236				
OV-10	0.0074	0.0074				
F-4	0.2291	0.2291				
F-14	0.1429	0.1429				
F-18	0.2105	0.2105				
	1.0000	1.0000	0.6267	TOTAL	130	5,118,387

A	X	Y	Z	AA	AB	AC
ACFT	DIRECT LAB COST BUDGET	SUPP LAB COST BUDGET	SA CONSUMABLES		DIR CONSUM COST BUDGET	DIR FIXED COST BUDGET
A-4	449,473	192,631			82,990	900,357
A-6	369,302	158,272			68,187	620,762
EA-6B	93,851	40,222	TRAVEL	26,570	17,328	201,401
A-7	472,438	202,473	OTHER CONTS	47,415	87,230	762,141
AV-8	84,453	36,194	CONSUMABLES	587,550	15,593	311,240
OV-10	26,513	11,363			4,895	17,772
F-4	820,754	351,752			151,543	1,149,048
F-14	511,956	219,410			94,527	925,892
F-18	754,131	323,199			139,241	1,166,572
	3,582,871	1,535,516	TOTAL	661,535	661,535	6,055,185

A	AD	AE	AF	AG	AH	AI	AJ
ACFT	DIR SHARE SU LABOR	DIR SHARE AM LABOR	DIR SHARE SAR LABOR	DIR SHARE CT LABOR	DIR SHARE SY LABOR	DIR ACFT OVHD LABOR BUDGET	DIR SHARE SU CONSUM
A-4				2,216	3,324	240,673	
A-6				1,008	1,512	197,745	
EA-6B				232	348	50,253	
A-7				1,952	2,928	252,970	
AV-8				382	573	45,221	
OV-10				208	312	14,197	
F-4				1,674	2,511	439,478	
F-14				1,178	1,767	274,130	
F-18				2,186	3,279	403,805	
	484,610	1,035,857	370,415	11,036	16,554	1,918,472	85,329

A	AK	AL	AM	AN	AO	AP	AQ
ACFT	DIR SHARE AM CONSUM	DIR SHARE OVHD CONSUM	DIR ACFT OVHD CONSUM BUDGET	DIR ACFT OVHD FIXED BUDGET	DIR ACFT TOT FIXED BUDGET	SA FHR	SA TOTAL BUDGET REV
A-4			18,967	259,640	1,159,997	1,762	1,952,660
A-6			15,584	213,329	834,091	2,947	1,485,370
EA-6B			3,960	54,213	255,615	3,630	421,125
A-7			19,936	272,906	1,035,047	1,914	1,868,209
AV-8			3,564	48,785	360,025	2,665	508,961
OV-10			1,119	15,316	33,087	768	79,845
F-4			34,634	474,112	1,623,161	3,669	3,070,593
F-14			21,604	295,734	1,221,626	3,607	2,124,480
F-18			31,823	435,627	1,602,199	2,683	2,932,140
	65,861	151,190	151,190	2,069,662	8,124,847		14,443,382

APPENDIX E

SAMPLE DATA

P3

	MON FUEL UNADJ	COST OF FUEL	MONTHLY FLT HRS	MONTHLY FUEL	MOV AV FLT HRS	MOV AV FUEL
OCT 83	4050	1.08	99.3	$3,750	169.2	65652
NOV 83	115035	1.08	137.5	$106,514	189.9	123212
DEC 83	93626	1.08	270.7	$86,691	184.4	125317
JAN 84	190546	1.08	161.4	$176,431	186.5	145663
FEB 84	121856	1.08	121.2	$112,830	241.0	158394
MAR 84	159547	1.08	277	$147,729	289.1	182201
APR 84	231795	1.08	324.8	$214,625	293.4	193152
MAY 84	198990	1.08	265.4	$184,250	252.8	195857
JUN 84	195028	1.08	290.1	$180,581	257.3	167048
JUL 84	240558	1.08	202.9	$222,739	256.2	207398
AUG 84	105648	1.08	278.9	$97,822	265.8	157200
SEP 84	325762	1.08	286.7	$301,631	230.6	167354
OCT 84	72146	1	231.9	$72,146	188.6	112079
NOV 84	128285	1	173.2	$128,285	185.7	133775
DEC 84	135807	1	160.6	$135,807	201.4	144935
JAN 85	137234	1	223.2	$137,234	204.9	135600
FEB 85	161763	1	220.4	$161,763	213.1	114637
MAR 85	107804	1	171.1	$107,804	229.6	69616
APR 85	74343	1	247.8	$74,343	256.1	100659
MAY 85	26700	1	269.8	$26,700	242.7	123278
JUN 85	200934	1	250.6	$200,934	238.5	190993
JUL 85	142199	1	207.8	$142,199	239.1	216854
AUG 85	229845	1	257.2	$229,845	235.3	207253
SEP 85	278518	1	252.2	$278,518	264.7	201403
OCT 85	94118	0.83	196.5	$113,395	222.6	190560
NOV 85	176206	0.83	345.4	$212,296	242.8	177737
DEC 85	204170	0.83	125.8	$245,988	156.1	165364
JAN 86	62189	0.83	257.3	$74,927	177.6	183844
FEB 86	145398	0.83	85.1	$175,178	204.3	218416
MAR 86	250184	0.83	190.3	$301,427	237.0	211884
APR 86	148273	0.83	337.5	$178,642	211.8	154359
MAY 86	129133	0.83	183.2	$155,582	161.9	198617
JUN 86	106947	0.83	114.6	$128,852	196.7	203765
JUL 86	258476	0.83	187.9	$311,417	228.7	275782
AUG 86	141953	0.83	287.5	$171,028	166.1	171976
SEP 86	286267	0.83	210.8	$344,900	70.3	114967

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	MON FUEL UNADJ	COST OF FUEL	MONTHLY FLT HRS	MONTHLY FUEL	MOV AV FLT HRS	MOV AV FUEL
OCT 80	0	1.27	64.2	$0	79.6	41064
NOV 80	72068	1.27	69.1	$56,746	114.9	57443
DEC 80	84387	1.27	105.5	$66,446	139.1	75215
JAN 81	62402	1.27	170.1	$49,135	143.0	90042
FEB 81	139782	1.27	141.8	$110,065	126.3	107239
MAR 81	140876	1.27	117.1	$110,926	137.1	64833
APR 81	127923	1.27	120	$100,727	145.0	50459
MAY 81	-21784	1.27	174.3	($17,153)	157.9	44552
JUN 81	86109	1.27	140.7	$67,802	167.0	96441
JUL 81	105417	1.27	158.8	$83,006	184.9	115633
AUG 81	175915	1.27	201.5	$138,516	175.8	102048
SEP 81	159229	1.27	194.3	$125,377	157.7	73763
OCT 81	59997	1.42	131.5	$42,251	137.5	78132
NOV 81	76198	1.42	147.3	$53,661	130.2	86243
DEC 81	196648	1.42	133.8	$138,485	118.9	93919
JAN 82	94549	1.42	109.6	$66,584	132.2	63552
FEB 82	108897	1.42	113.4	$76,688	152.3	80896
MAR 82	67286	1.42	173.7	$47,385	168.2	102342
APR 82	168433	1.42	169.8	$118,615	150.3	110884
MAY 82	200260	1.42	161.2	$141,028	191.3	134472
JUN 82	103673	1.42	119.8	$73,009	195.7	147600
JUL 82	268916	1.42	292.9	$189,377	216.2	181738
AUG 82	256188	1.42	174.3	$180,414	186.7	117990
SEP 82	249101	1.42	181.4	$175,423	183.9	99986
OCT 82	-2353	1.26	204.5	($1,867)	169.7	95619
NOV 82	159267	1.26	165.7	$126,402	150.2	117081
DEC 82	204524	1.26	138.9	$162,321	129.6	120093
JAN 83	78775	1.26	146.1	$62,520	141.7	98538
FEB 83	170652	1.26	103.7	$135,438	148.0	110706
MAR 83	123048	1.26	175.4	$97,657	147.6	98041
APR 83	124770	1.26	164.8	$99,024	169.5	109137
MAY 83	122776	1.26	102.6	$97,441	158.6	83666
JUN 83	164992	1.26	241	$130,946	201.0	93536
JUL 83	28491	1.26	132.3	$22,612	222.6	130538
AUG 83	160083	1.26	229.6	$127,050	211.6	124251
SEP 83	304859	1.26	306	$241,952	180.9	117405

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	MON PARTS UNADJ	INFLATION FACTOR	MONTHLY FLT HRS	MONTHLY PARTS	MOV AV FLT HRS	MOV AV PARTS
OCT 83	4206	0.955	99.3	$4,017	169.2	22582
NOV 83	52456	0.955	137.5	$50,095	189.9	30279
DEC 83	14277	0.955	270.7	$13,635	184.4	21806
JAN 84	28384	0.955	161.4	$27,107	186.5	19669
FEB 84	25841	0.955	121.2	$24,678	241.0	24089
MAR 84	7563	0.955	277	$7,223	289.1	25171
APR 84	42268	0.955	324.8	$40,366	293.4	33662
MAY 84	29239	0.955	265.4	$27,923	252.8	38210
JUN 84	34236	0.955	290.1	$32,695	257.3	91200
JUL 84	56555	0.955	202.9	$54,010	256.2	74940
AUG 84	195702	0.955	278.9	$186,895	265.8	60953
SEP 84	-16842	0.955	286.7	($16,084)	230.6	8754
OCT 84	12047	1	231.9	$12,047	188.6	49699
NOV 84	30300	1	173.2	$30,300	185.7	71655
DEC 84	106751	1	160.6	$106,751	201.4	88752
JAN 85	77915	1	223.2	$77,915	204.9	106122
FEB 85	81590	1	220.4	$81,590	213.1	82936
MAR 85	158862	1	171.1	$158,862	229.6	61314
APR 85	8355	1	247.8	$8,355	256.1	15763
MAY 85	16726	1	269.8	$16,726	242.7	14092
JUN 85	22208	1	250.6	$22,208	238.5	59209
JUL 85	3343	1	207.8	$3,343	239.1	65336
AUG 85	152076	1	257.2	$152,076	235.3	64222
SEP 85	40590	1	252.2	$40,590	264.7	19039
OCT 85	0	1.045	196.5	$0	222.6	29628
NOV 85	15815	1.045	345.4	$16,527	242.8	33760
DEC 85	69241	1.045	125.8	$72,357	156.1	57423
JAN 86	11864	1.045	257.3	$12,398	177.6	44456
FEB 86	83747	1.045	85.1	$87,516	204.3	48239
MAR 86	32013	1.045	190.3	$33,454	237.0	21328
APR 86	22725	1.045	337.5	$23,748	211.8	8423
MAY 86	6492	1.045	183.2	$6,784	161.9	6479
JUN 86	-5037	1.045	114.6	($5,264)	196.7	15495
JUL 86	17144	1.045	187.9	$17,915	228.7	31446
AUG 86	32375	1.045	287.5	$33,832	166.1	25474
SEP 86	40756	1.045	210.8	$42,590	70.3	14197

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	MON PARTS UNADJ	INFLATION FACTOR	MONTHLY FLT HRS	MONTHLY PARTS	MOV AV FLT HRS	MOV AV PARTS
OCT 80	189	0.823	64.2	$156	79.6	6069
NOV 80	521	0.823	69.1	$429	114.9	10639
DEC 80	21412	0.823	105.5	$17,622	139.1	16666
JAN 81	16849	0.823	170.1	$13,867	143.0	17678
FEB 81	22489	0.823	141.8	$18,508	126.3	20432
MAR 81	25103	0.823	117.1	$20,660	137.1	24380
APR 81	26886	0.823	120	$22,127	145.0	24244
MAY 81	36881	0.823	174.3	$30,353	157.9	21718
JUN 81	24606	0.823	140.7	$20,251	167.0	34844
JUL 81	17681	0.823	158.8	$14,551	184.9	33717
AUG 81	84727	0.823	201.5	$69,730	175.8	30179
SEP 81	20496	0.823	194.3	$16,868	157.7	19721
OCT 81	4537	0.868	131.5	$3,938	137.5	21930
NOV 81	44191	0.868	147.3	$38,358	130.2	23981
DEC 81	27066	0.868	133.8	$23,493	118.9	22788
JAN 82	11628	0.868	109.6	$10,093	132.2	18405
FEB 82	40067	0.868	113.4	$34,778	152.3	28305
MAR 82	11918	0.868	173.7	$10,345	168.2	29613
APR 82	45844	0.868	169.8	$39,793	150.3	32547
MAY 82	44586	0.868	161.2	$38,701	191.3	24352
JUN 82	22058	0.868	119.8	$19,146	195.7	17713
JUL 82	17522	0.868	292.9	$15,209	216.2	24903
AUG 82	21640	0.868	174.3	$18,784	186.7	21869
SEP 82	46908	0.868	181.4	$40,716	183.9	46547
OCT 82	6704	0.911	204.5	$6,107	169.7	41192
NOV 82	101884	0.911	165.7	$92,816	150.2	43949
DEC 82	27060	0.911	138.9	$24,652	129.6	38073
JAN 83	15784	0.911	146.1	$14,379	141.7	58094
FEB 83	82533	0.911	103.7	$75,188	148.0	85868
MAR 83	92992	0.911	175.4	$84,716	147.6	66374
APR 83	107247	0.911	164.8	$97,702	169.5	52908
MAY 83	18336	0.911	102.6	$16,704	158.6	19881
JUN 83	48647	0.911	241	$44,317	201.0	22446
JUL 83	-1513	0.911	132.3	($1,378)	222.6	64045
AUG 83	26781	0.911	229.6	$24,397	211.6	65843
SEP 83	185637	0.911	306	$169,115	180.9	74409

APPENDIX F

EXAMPLE BUDGET

First Quater Budget

1	2	3	4	5	6	7	8
ACFT	TRAIN HRS	PROJ HRS	TOTAL HRS 88	FUEL USE GAL/HR	FUEL COST/GAL	FUEL RATE FOR FY 88	FUEL COST FOR FY 88
A-3	32.5	35	67.5	1200	0.68	816	55,080
A-6	6.25	12.5	18.75	985	0.68	670	12,559
A-7	37.5	87.5	125	707	0.68	481	60,095
F-4	22.5	52.5	75	1243	0.68	845	63,393
F-14	32.5	130	162.5	1163	0.68	791	128,512
F-18	28.25	84.5	112.75	1070	0.68	728	82,037
H-46	162	63	225	155	0.68	105	23,715
C-12	143	132	275	92	0.68	63	17,204
P-3	100	462.5	562.5	708	0.68	481	270,810
	564.5	1059.5	1624				713,404

1	9	10	11
ACFT	PARTS	INFLATION FACTOR	PARTS COST
A-3	14640	1.13	16,543
A-6	16238	1.13	18,349
A-7	6883	1.13	7,778
F-4	8793	1.13	9,936
F-14	37499	1.13	42,374
F-18	34683	1.13	39,192
H-46	19242	1.13	21,743
C-12	BASI CONTRACT		210,000
P-3	37394.5	1.13	42,256
			408,171

1	12				13	14	15	16
ACFT	LABOR COSTS				GSE COSTS	LEVEL 2 COSTS	TRAIN COSTS	COSTS TO BE NORMALIZED
A-3								
A-6	CIVILIANS		87	306,000				
A-7	CONTRACTOR							
F-4		GTSI	81	620,325				
F-14		GAC	33	568,750				
F-18		HAC	5	106,250				
H-46		MCAIR	3	66,250				
C-12								
P-3								
				1,667,575	449,342	171,559	20237.2	2,288,476

1	N	17	18	19	20	21	22
ACFT	O	MMH	TOTAL	MMH	NORM	TOTAL	FHR
	R		MMH	RATE	SHARE	COSTS	PROPOSED
	M						
A-3	A	56	3780		180152.0	251,775	3,730
A-6	L	55.5	1040.625		49595.44	80,503	4,294
A-7	I	38.5	4812.5		229360.2	297,233	2,378
F-4	Z	43.5	3262.5		155488.4	228,817	3,051
F-14	A	58.8	9555		455384.4	626,270	3,854
F-18	T	27.2	3066.8		146161.4	267,390	2,372
H-46	I	25.5	5737.5		273445.1	318,904	1,417
C-12	O	0	0			227,204	826
P-3	N	29.8	16762.5		798888.7	1,111,954	1,977
			48,017	47.65928	2288476	3,410,051	

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